THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

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VOL. IX.—FIFTH SERIES.

LONDON:

PRINTED AND PUBLISHED BY TAYLOR AND FRANCIS.

SOLD BY LONGMANS, GREEN, READER, AND DYER; SIMPKIN, MARSHALL, AND CO.; KENT AND CO.; WHITTAKER AND CO.: BAILLIÈRE, PARIS: MACLACHLAN AND STEWART, EDINBURGH: HODGES, FOSTER, AND CO., DUBLIN: AND ASHER, BERLIN.

1882.

"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

"................. per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hìc carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 49. JANUARY 1882.

I.—*Notes on British Spiders, with Descriptions of three new Species and Characters of a new Genus.* By the Rev. O. P. CAMBRIDGE, M.A., C.M.Z.S., &c.

[Plate I.]

UPWARDS of two years have passed since my last communication reporting progress on British araneology (Ann. & Mag. N. H. (5) iv. p. 190, pl. xii., Sept. 1879). In the meantime part ii., completing 'Spiders of Dorset,' has been published*, and contains notices and descriptions of all the species of British spiders known up to the beginning of 1881. Figures of several of the new species described, but not figured, in that work are now given, in the hope that they may assist collectors in their determination of the species. The number of spiders recorded in Great Britain and Ireland (including those here described as new) is 520; but there is little doubt that this number might be considerably increased by diligent search in many as yet untried localities, especially when we consider that a small area of Dorsetshire alone has produced nearly 400 species.

* Proceedings of the Dorset Natural-History and Antiquarian Field Club, 1879–81, pp. 1–625, pls. i.–vi. (Sherborne, Dorset: L. H. Ruegg.)

Order Araneidea.

Fam. **Drassidæ.**

Genus Clubiona, Latr.

Clubiona cærulescens, L. Koch.

Clubiona cærulescens, L. Koch, Die Arachn.-Fam. der Drassiden, p. 331, Taf. xiii. figs. 213–215; Cambridge, Spiders of Dorset, p. 29.
Clubiona voluta, Cambr. Linn. Soc. Journ. xi. p. 553, pl. xiv. fig. 3.

Two adult males of this fine and striking species were found by myself on the 6th of September, 1881, on low plants among short underwood near Bloxworth. This is the first recorded occurrence of the male in Britain, the only examples previously recorded (one at Bloxworth and one near Aberdeen) being females.

Fam. **Dictynidæ.**

Genus novum Amphissa (nom. propr.).

Cephalothorax rather elongate-oval, somewhat broadly truncated behind; upper convexity very moderate; profile-line even and slightly curved; lateral constriction at caput as well as the normal indentations very slight. Clypeus low.

Eyes not very large, subequal, closely grouped together in two parallel, transverse contiguous rows, of which the posterior is nearly straight. The interval between the eyes of the hind central pair (which are smaller than the hind laterals, and of a somewhat misshapen form) exceeds a diameter; and each is contiguous to the hind lateral eye on its side. The eyes of the anterior row are contiguous to each other.

Legs moderate in length and strength (4, 1, 2, 3), furnished with hairs and a very few spines. In the only example known (which is a male) two of these spines are short, black, and placed in a longitudinal line beneath the metatarsi of the first pair, and another, long, rather strong, prominent, and curved, beneath the tibiæ of the third pair. Each tarsus ends with three curved claws, the inferior one being very small.

Falces moderately long, not very strong, vertical, and slightly divergent at their extremities.

Maxillæ moderate in length, strong, inclined towards the labium, and obliquely truncated at their extremity on the inner sides.

Labium not very large, its apex drawn out into a point reaching to the inner extremity of the maxillæ.

Sternum heart-shaped.

Abdomen rather narrow-oval, moderately convex above, and not projecting over the base of the cephalothorax. Spinners placed beneath rather than at the posterior extremity; and immediately in front of the ordinary ones is a transverse supernumerary spinning-organ, correlated with which, in the female, there would doubtless be found calamistra on the metatarsi of the fourth pair of legs.

Amphissa spinigera. (Pl. I. fig. 1.)

Lethia spinigera, Cambr. Spiders of Dorset, p. 468.

Length of the adult male $\frac{1}{14}$ of an inch.

The general colouring of this curious and minute spider is yellow-brown, all the femora, especially of the legs of the first pair, being strongly tinged with blackish brown. The abdomen has the appearance in spirit, under a lens, of being minutely spotted with dull reddish-yellow points; and several pale transverse angular lines are visible on the hinder part of the upperside. The single longish black curved prominent spine beneath the tibiæ of the third pair of legs is very characteristic; but whether of generic or only specific value (and, if the latter, then whether only sexual) is uncertain.

When first described (*l. c. suprà*) I included this spider doubtfully in the genus *Lethia*, Menge. Subsequent examination, however, of the *eyes*, *maxillæ*, and *labium* have convinced me that a new genus is necessary for its reception. It is, moreover, a much more Drassiform spider than the known species of *Lethia*.

The example above described was found in his study, and kindly sent to me, by F. M. Campbell, Esq., of Hoddesdon, in the early part of 1880.

Fam. **Agelenidæ.**

Genus Hahnia, C. L. Koch.

Hahnia helveola, Sim.

Hahnia helveola, Sim. Arachn. de France, ii. p. 139; Cambridge, Spiders of Dorset, p. 72.

Several adult males were found among moss near Bloxworth (with numerous females also), on the 9th of November 1881. Up to that time I had met with the females only, this sex being more or less abundant at most other periods of the year.

Fam. **Theridiidæ.**

Genus Dipœna, Thor.

Dipœna melanogaster, C. L. Koch.

Atea melanogaster, C. L. Koch, Die Arachn. xi. p. 143, pl. ccexcii. figs. 941, 942; Cambridge, Spiders of Dorset, p. 478.
Theridion congener, Cambr. Zoologist, 1863, p. 8576.

On the 13th of June, 1881, I met with an adult male of this rare spider on a furze bush on Bloxworth Heath; its only previous record as a British species is that of a female near Lyndhurst, Hants, in July 1858.

Genus Euryopis, Menge.

Euryopis flavomaculata, C. L. Koch.

Micryphantes flavomaculatus, C. L. Koch, Die Arachn. iii. p. 67, Taf. xcv. fig. 220.
Theridion flavomaculatum, Blackw. Spid. Great Brit. and Irel. p. 201, pl. xiv. fig. 132.
Euryopis flavomaculata, Cambr. Spiders of Dorset, p. 100.

On the 14th of June, 1881, I found an adult female under a thin clod of earth on Bloxworth Heath; it had only occurred once previously in this district (an adult male, in the month of June, about ten years ago), crossing the path in a wood.

Genus Neriene, Bl.

Neriene innotabilis, Cambr.

Neriene innotabilis, Cambr. Spiders of Dorset, pp. 131 and 574.

Adult females were found among dead leaves in woods near Hoddesdon at the beginning of July 1881. I have usually found the males adult at Bloxworth in May and the beginning of June. The epigyne is large and very prominent.

Neriene agrestis, Bl. (Pl. I. fig. 2 *b*.)

Neriene agrestis, Bl. Spid. Great Brit. & Irel. p. 276 (excluding references to the figures in pls. xix. and xxii.); Cambr. Spiders of Dorset, p. 486.

While on a visit to Mr. F. M. Campbell at Hoddesdon, in July 1881, I met with several examples of both sexes of this spider among low plants, and under stones in the damp oozy bed of a small stream, where it appears to be of frequent occurrence, though confined to that one spot.

The *female*, in respect to the form of the genital aperture

(Pl. I. fig. 2 *b*), very nearly resembles that of the species which I take to be *Neriene fusca*, Bl. (Pl. I. fig. 2 *a*); but its colours, like those of the male, are much richer, the legs being of a bright reddish orange, and the abdomen quite black, without any longitudinal pale stripe on the upperside, which is always present in *N. fusca*. It is very difficult to decide with absolute certainty on the identity of *N. agrestis*, Bl., and *N. fusca*, Bl. The female of *N. agrestis*, described by Mr. Blackwall, agrees best with those females which I have found always in company with the males of his *N. fusca*, while the female of this latter agrees better in some respects with those I found in company with the males above recorded at Hoddesdon. It seems to me very probable that, as both species occurred in Mr. Blackwall's district, and apparently in equal abundance, he may have confused the females of the two. Another element of confusion has arisen from Mr. Blackwall having lost all his types of both species, and supplied his artist with examples for the illustration of each, in his work above quoted, furnished by myself, but which, it has been since ascertained, all belong to one species only. This species is the one which, after much consideration, I conclude to be *N. fusca,* Bl. It is very abundant in this district, where, as yet, I have never met with the other. The males of *N. fusca*, Bl.-Cambr., are the smallest and lightest-coloured of the two, and have the occiput distinctly and decidedly gibbous in profile, while the females, similar in general colouring, have always, or very nearly always, the median longitudinal line on the upperside of the abdomen paler than the rest, often amounting to a distinct stripe, the general colour of the abdomen being yellowish brown. In the other species, which I conclude to be *N. agrestis*, Bl., the males are not only larger than those above mentioned, but the colouring is much darker and richer, the legs being of a bright orange red-brown, and the abdomen black, while the profile of the occiput shows no gibbosity, being merely convex or simply curved.

At Hoddesdon I also found both sexes of the species which I take to be *N. fusca*, Bl., but not in the same locality as that in which the other species occurred.

In the same month (July 1881) an adult male of *N. agrestis*, Bl.-Cambr., was found by my nephew, F. O. P. Cambridge, near Southwell, in Nottinghamshire. I have also received it from Dr. L. Koch from Nuremberg; and Mons. Simon tells me that he finds it, though less commonly than its near ally *N. fusca*, Bl.-Cambr., in France.

Neriene excisa, Cambr.

Neriene excisa, Cambr. Spiders of Dorset, p. 487, and Trans. Linn. Soc. xxvii. p. 440, pl. lvi. no. 29.

Adult males of this very distinct species were found in a swamp near Bloxworth by Mr. F. M. Campbell on the 8th of September 1881; and subsequently both sexes have been met with on several occasions on the same spot by myself. This is its first record in the south of England, the typical examples having been found some years ago and kindly sent to me from Northumberland by Mr. James Hardy, of Old Cambus.

Neriene uncata, Cambr.

Neriene uncata, Cambr. Spiders of Dorset, p. 433; and Trans. Linn. Soc. xxviii. p. 546, pl. xlvi. fig. 17.

On the 16th of September, 1881, and again in November of the same year, I found adults of both sexes of this fine species, the females in considerable abundance, in a swamp near Bloxworth.

Neriene formidabilis, Cambr.

Neriene formidabilis, Cambr. Spiders of Dorset, p. 135.

On the 22nd of November, 1881, I met with an adult female of this spider in a swamp near Bloxworth. This example measures a little over $\frac{1}{3}$ of an inch in length; but in other respects it exactly agrees with the typical specimen. The spiracular plates in both examples are of a pale yellowish hue.

Neriene lapidicola, Thor.

Neriene rufipes, Bl. Spid. Great Brit. & Irel. p. 251.
Neriene lapidicola, Thor., Cambr. Spiders of Dorset, p. 489.

Two adult females (found in the same locality and at the same time as the last species) differed in being smaller; the eyes also are smaller, and those of the hinder row are divided by equal intervals, whereas in *N. formidabilis* the interval between those of the hind central pair is distinctly smaller than that between each and the hind lateral eye next to it. The general colouring and appearance, however, of the two spiders is very similar; the spiracular plates are also pale yellowish in both; and the genital apertures are much alike. I am inclined to think that the two examples now recorded are the females of *N. rufipes*, Bl., a spider to which Dr. Thorell has given the specific name of *lapidicola*, in consequence of the name *rufipes* being preoccupied by a species of the same group named by Prof. Sundevall of Sweden. Whether these two or the spiders I have named *N. formidabilis* are the true

N. rufipes of Blackwall can scarcely be determined until I shall have been fortunate enough to meet with their respective males; either of them would fairly answer to Mr. Blackwall's description, though, in regard to the type of *N. formidabilis*, it may be remarked that the late Mr. Blackwall examined it some years ago, and returned it to me as unknown to him.

Neriene laudata, Cambr. (Pl. I. fig. 3.)

Walckenaëra laudata, Cambr. Spiders of Dorset, p. 591.

I have again met with this spider during the summer of 1881 on Bloxworth Heath; and further examination leads me to remove it from the genus *Walckenaëra* to *Neriene*, to which last the position of the eyes appears to bring it nearer than to the former.

Genus Walckenaëra, Bl.

Walckenaëra diceros, Cambr.

Walckenaëra diceros, Cambr. Spiders of Dorset, p. 145, pl. iii. fig. 6.

On the 14th of April I met with an adult male of this exceedingly minute and rare spider among grass and weeds near the riverside at Hyde, near Bloxworth. I had not met with it previously for more than twelve years. The example now recorded differs from the type specimens only in being of a deeper, richer yellow-brown colour.

Walckenaëra penultima, sp. n. (Pl. I. fig. 4.)

Adult male, length $\frac{1}{16}$ of an inch.

The caput is slightly but roundly elevated; and in profile the spider has somewhat the look of *Walckenaëra pumila*, Bl., the darker colouring of which species, however, as well as its very characteristic palpi and palpal organs, will prevent any confusion between the two. The height of the clypeus is about equal to half that of the facial space; and from just above each lateral pair of eyes a strong longitudinal tapering indentation runs back nearly to the occiput; a few bristly hairs are directed forwards from just behind and within the ocular area, in the median line.

The colour of the *cephalothorax* is pale yellow margined by a fine black line, the elevated portion of the caput yellow-brown; the legs light yellow, strongly suffused with sooty-brownish on the tibiæ and metatarsi, chiefly of the first and second pairs. The abdomen is dull yellowish brown, suffused towards and on the underside with a dusky brown hue.

The *eyes* are very small, seated on small black spots, those of the fore central and two lateral pairs form a transverse curved row, each fore central eye being separated from the fore lateral next to it by an eye's diameter. The eyes of the hind central pair are separated by rather more than a diameter's interval, and, with those of the fore central pair (which are the smallest and nearly contiguous to each other), form a long narrow trapezoid, whose length is about double its width at the upper (or hinder) part.

The *palpi* are similar in colour to the legs, and short; the radial is shorter but stronger than the cubital joint, and has its fore extremity on the upperside a little prominent, with two very small points at its most prominent part, one of these points (the largest) being obtuse and black, and the other acute and pale. The digital joint is small, oval; the palpal organs are simple, not much developed, and have a small, fine, black, curved, filiform spine at their extremity.

The *falces* are rather weak, straight, and slightly inclined backwards towards the labium.

The *legs* are short, tolerably strong; the tibiæ only a little less strong than the femora; they are furnished with coarsish hairs and a few erect bristles.

The *sternum* is convexly prominent, margined narrowly with black, and strongly suffused with dusky brown. It is of a short heart-shape or somewhat subtriangular.

The *abdomen* is oval, and projects considerably over the base of the thorax.

An adult and an immature male of this spider (which in colours nearly resembles *Walckenaëra ludicra*, Cambr.) were found among heather on Bloxworth Heath, on the 8th and 29th of April, 1881.

Walckenaëra melanocephala, Cambr. (Pl. I. fig. 5.)

Walckenaëra melanocephala, Cambr. Spiders of Dorset, p. 596.

Three adult examples (two females and one male) were found on the 24th of July, 1881, among grass in paths in a wood at Bloxworth, where I had found the typical examples in the same month of the previous year. It is perhaps one of the most striking species, from the strong contrast of its colours, among those found in Great Britain.

Walckenaëra mitis, sp. n. (Pl. I. fig. 6.)

Length of the adult female $\frac{1}{16}$ of an inch.

The colour of the cephalothorax, legs, palpi, falces, maxillæ,

and labium is yellow-brown, the sternum yellowish, and the abdomen pale dull luteous.

The *cephalothorax* is of an oblong form, slightly rounded at each end, the hinder part being rather broader than the fore part. The normal indentations are indistinct, and the lateral constriction of the caput very slight. The height of the clypeus equals, or is perhaps rather less than, half that of the facial space.

The *eyes* are small, in two curved rows, forming a tolerably compact transverse oval figure. The posterior row is the longest and most curved, and its eyes are equally separated from each other by about an eye's diameter; those of the lateral pairs are rather the largest. The fore central pair are very minute and, with the hind centrals, form a trapezoid, whose length is a little greater than its breadth at the hinder part, and the anterior side is much the narrowest.

The *legs* are short and slender, 4, 1, 2, 3, the difference between those of the first and fourth pairs being very slight.

The *falces* are of moderate size and strength, straight and vertical.

The *maxillæ* are short, strong, straight, and obliquely truncated at their extremity on the outer side.

The *labium* is short and semicircular.

The *abdomen* is oval, bluff at the hinder extremity, considerably convex on the upperside, and projects a good deal over the base of the cephalothorax. The genital aperture is of characteristic structure, and is comprised in a rather large dark yellow-brown and blackish horseshoe-shaped area, forming a very conspicuous object in contrast to the pale colour of the abdomen.

Four examples of this little spider were found among moss near Bloxworth on the 29th of April, 1881.

It seems to be allied to *W. ingrata*, Cambr., but may be easily distinguished by the form and colour of the genital aperture.

Walckenaëra miser, sp. n. (Pl. I. fig. 7.)

Length of the adult female 1 line.

The colour of the *cephalothorax* is dull yellow (slightly tinged with orange-brown) margined with a black line, and more or less suffused on the sides (towards the margins) and at the thoracic junction with blackish. All the rest of the fore part is also of a similar colour, excepting the tibiæ of the first and second pairs of legs, which are deep yellow-brown, and the sternum, which is strongly suffused with blackish brown. The metatarsi also of the legs above mentioned are suffused, but less strongly, with yellow-brown.

The caput is broadish and bluff before, and slightly constricted on the lateral margins. Looked at in profile the occipital region is very slightly but perceptibly and roundly raised, just sufficiently so to interrupt the even curve of the general profile-line; at the posterior part of the occiput is a small blackish suffusion, into which a suffused line of a similar colour runs from each hind lateral eye.

The height of the clypeus is rather less than half that of the facial space.

The *eyes* are of moderate size, seated on black spots, and form a largish area on the anterior upper slope of the caput; the posterior row is the longest and very strongly curved, the anterior row being very nearly straight. The intervals between the eyes of the posterior row are similar, being each equal to about an eye's diameter. Those of each lateral pair are seated obliquely on a slight tubercle.

The *legs* are strongish but not very long, nor greatly unequal in length, furnished with hairs and a few fine erect bristles; 4, 1, 2, 3.

The *falces* are moderate in length, strong, straight, and vertical; armed with a few very minute teeth on each side of the groove in which the fang lies when at rest.

The *maxillæ*, *labium*, and *sternum* do not present any noteworthy characters.

The *abdomen* is oval, and projects strongly over the base of the cephalothorax; it is of a dull brownish-yellow colour, the sides and underpart more or less suffused with blackish brown; and it is thinly clothed with short fine hairs.

The genital aperture is inconspicuous and very simple in form, consisting of a small oblong aperture with an oblique narrow oblong-oval dark brown marking on each side of it, probably denoting the position, beneath, of the spermathecæ.

An example of this spider was found among moss in October 1879, at Bloxworth; and another has been since received from Northumberland. It does not appear to me to belong to any species of which the male has yet been described; and its colours and form rendering it a characteristic species, I am induced to describe it as new.

If it were not that the eyes are so much larger, I should have considered that it might be the female of *W. penultima*, to which in colours it bears a strong resemblance.

Genus Linyphia, Latr.

Linyphia pallida, Cambr.

Linyphia pallida, Cambr. Spiders of Dorset, p. 216; and Trans. Linn. Soc. xxvii. p. 435, p. lvi. no. 26.

In June 1880, and again in June and July 1881, I have

found several examples of both sexes of this very distinct species, among grass and low herbage, in woods at Bloxworth. I had not met with it since March 1867. An adult male was also found at Hoddesdon, Hertfordshire, in June 1881, by Mr. F. M. Campbell.

Linyphia experta, Cambr.

Linyphia experta, Cambr. Spiders of Dorset, p. 203; and Trans. Linn. Soc. xxvii. p. 429, pl. lv. no. 23.

Adults of both sexes in some abundance occurred in a swamp near Bloxworth, in November 1881. The only example (a male) before recorded in this district, occurred in the village schoolroom at Bloxworth, in December 1867, brought in probably among the turf and sticks used for fuel. Several examples were subsequently received from Mr. James Hardy, by whom they were found in Berwickshire.

Linyphia approximata, Cambr.

Linyphia approximata, Cambr. Spiders of Dorset, p. 199; and Linn. Trans. xxvii. p. 424, pl. lv. no. 19.

I have not met with this spider since its first discovery in May 1863, until May 1, 1880, and also during the present year (1881), when in May, and again in September and November, I found several adults of both sexes in another part of the same marsh where it had previously occurred. Adults would probably be obtained in mild weather during the whole winter.

Fam. **Epeiridæ.**

Genus Epeira.

Epeira alsine, Walck.

Epeira alsine, Walck., Cambr. Spiders of Dorset, p. 530.

An adult male of this handsome spider was found among rushes in a marshy spot near Bloxworth, on the 27th of August 1881; and a few days later another adult of the same sex, with an immature female, were met with among low plants in Berewood, adjoining Bloxworth. This is the first record of the male in Great Britain, and of the occurrence of the species in this district.

The only examples previously recorded were found near Tring, in Hertfordshire, some years ago.

Fam. Thomisidæ.

Genus PHILODROMUS, Walck.

Philodromus elegans, Bl.

Philodromus elegans, Bl. Spid. Great Brit. & Irel. p. 94, pl. v. fig. 57; Cambr. Spiders of Dorset, p. 334.

This fine *Philodromus* has been unusually abundant during the past autumn (1881) on Bloxworth Heath; but, although I have examined numerous examples from time to time up to the 1st of November, no male in the adult state has been yet met with. Some few of the *females* were adult on the 17th and 31st of October; but all the *males* had the digital joints of the palpi still in a tumid state. On the day last mentioned I placed four males alive in separate bottles, and have since fed them with flies; they are up to the present time (December 5th) well and active; but the palpal organs are still undeveloped, leading me to conclude that they do not attain complete maturity until the early spring.

List of Spiders noted and described.

EXPLANATION OF PLATE I.

Fig. 1. *Amphissa* (g. n.) *spinigera*, Cambr., ♂. *a*, spider, enlarged; *b*, profile of cephalothorax and abdomen; *c*, eyes and falces, from in front; *d*, maxillæ and labium; *e*, left leg of third pair, from the outer side; *f*, portion of left palpus, from above and behind; *g*, natural length of spider.

Fig. 2 *a*. *Neriene fusca*, Bl., genital aperture of female.

Fig. 2 *b*. *Neriene agrestis*, Bl., genital aperture of female.

Fig. 3. *Neriene laudata*, Cambr., ♂. *a*, profile of cephalothorax and abdomen, greatly enlarged; *b*, outline of ditto from above; *c*, fore part of caput and eyes of male, from above and behind; *d*, right palpus of male, from outer side in front; *e*, ditto, from

inner side in front and turned upwards; *f*, genital aperture of female; *g*, natural length of spider (♂).

Fig. 4. *Walckenaëra penultima*, sp. n., ♂. *a*, profile of cephalothorax and fore part of abdomen, greatly enlarged; *b*, fore part of caput and eyes, from above and behind; *c*, left palpus, from above and behind; *d*, natural length of spider.

Fig. 5. *Walckenaëra melanocephala*, Cambr. *a*, profile of cephalothorax and abdomen of male, much enlarged; *b*, cephalothorax of male, showing form of caput and eyes, from above and behind; *c*, profile of cephalothorax of female; *d*, eyes and falces of female from in front; *e*, right palpus of male inverted, from outer side in front; *f*, genital aperture of female; *g*, natural length of spider (♂).

Fig. 6. *Walckenaëra mitis*, sp. n., ♀. *a*, profile of cephalothorax and abdomen, much enlarged; *b*, cephalothorax from above and behind; *c*, eyes, from in front; *d*, genital aperture; *e*, natural length of spider.

Fig. 7. *Walckenaëra miser*, sp. n., ♀. *a*, cephalothorax and fore part of abdomen, in profile, much enlarged; *b*, outline of cephalothorax and abdomen, from above; *c*, fore part of caput and eyes, from above; *d*, eyes, from in front; *e*, genital aperture; *f*, natural length of spider.

II.—*On Lepidoptera collected in Japan and the Corea by Mr. W. Wykeham Perry.* By Arthur G. Butler, F.L.S., F.Z.S.

Mr. W. Wykeham Perry, of H.M.S. 'Iron Duke,' has recently sent to the Museum an interesting series of Lepidoptera (all, with two exceptions, referable to the Rhopalocera), collected by himself in Hakodaté, Yokohama, Kobé, and at Posiette Bay, Corea, during the present year.

Although the species obtained in Japan exhibit the ordinary features of all small collections received from these islands, it is nevertheless interesting to us to obtain, for the first time, specimens from Kobé. But the most important portion of this consignment is the series from Posiette Bay, as giving us some idea of the Lepidopterous fauna of the Corea; it represents a combination of Japanese, European, and Chinese features which is most instructive.

If any lepidopterist should assert (upon the authority of specimens not received direct from collectors, but purchased through dealers) that the species of Japan and Amurland are for the most part identical, Mr. Perry's Corean series must present a difficulty to be solved. It contains, in several instances, Japanese and European types of closely allied species side by side; and those forms which are common in Eastern Siberia seem to be equally abundant in N.E

Corea; those forms which have their representatives in Japan are more worn and rubbed than the typical Japanese species occurring with them, thus indicating that their time of emergence from the pupa is earlier. The fresher species are chiefly females, the males having not yet emerged when Mr. Perry left the country.

For my part, knowing that Lepidoptera said to come from the Amur fetch a higher price than their allies from Japan, I should at all times receive with the greatest caution any statement of the identity of specimens the history of which was not beyond all question.

The following is a list of the species:—

Nymphalidæ.

Satyrinæ.

1. *Satyrus dryas.*

Papilio dryas, Scopoli, Ent. Carn. p. 153, fig. 429 (1763).

Posiette Bay, Corea, N.E., August 1881.

2. *Satyrus bipunctatus.*

Satyrus bipunctatus, Motschulsky, Etudes Entom. ix. p. 29 (1860).

Hakodaté and Kobé, in July; Yokohama and Posiette Bay, Corea, in August.

3. *Satyrus hyperantus.*

Papilio hyperantus, Linnæus, Fauna Suecica, p. 273 (1761).

Posiette Bay, Corea, N.E., August 1881.

4. *Satyrus ocellatus*, sp. n.

♀. Nearly allied to *S. hyperantus*, but with all the ocelli of about three times the size; those on the under surface with confluent irides and oval in form. Expanse of wings 2 inches.

Posiette Bay, Corea.

Although the ocelli in *S. hyperantus* are very variable, this variation is in a decreasing direction from the normal condition; I have never seen them enlarged so as to give the insect the aspect of a *Mycalesis* or *Ypthima*; and therefore I have thought it best to give this form a name.

5. *Neope Fentoni.*

Neope Fentoni, Butler, Ann. & Mag. Nat. Hist. ser. 4, vol. xix. pl. xci. (1877).

♂ ♀. Posiette Bay, Corea.

The male has the under surface of the secondaries coloured exactly as in Ménétriés's figure of the female.

6. *Lethe sicelis.*

Debis sicelis, Hewitson, Exot. Butt. iii. *Deb.* pl. i. fig. 3 (1862).

Yokohama, August 1881.

Two very much worn female examples were obtained, proving that its time of appearance must be much earlier in the year.

7. *Sadarga gotama.*

Mycalesis gotama, Moore, Cat. Lep. Mus. E. I. Comp. i. p. 232 (1857).

Yokohama, August.

8. *Ypthima argus.*

Ypthima argus, Butler, Journ. Linn. Soc. Zool. ix. p. 56 (1866).

Hakodaté (July); Yokohama (August).

9. *Melanargia halimede.*

Arge halimede, Ménétriés, Bull. Acad. Petr. xvii. p. 216 (1859); Schrenck's Reisen, ii. p. 37, pl. iii. figs. 6, 7 (1859).

Twelve examples, Posiette Bay, N.E. Corea, in August.

Of the specimens obtained nine are perfectly typical; but three (two males and a female) are somewhat melanized, so as to show a tendency to approach the Chinese species *M. meridionalis*; the differences on both surfaces, however, are too strongly marked to permit one for a moment to think of regarding them as truly intermediate forms; they still exhibit the characteristics of *M. halimede.*

Nymphalinæ.

10. *Argynnis coreana*, sp. n.

Nearly allied to *A. nerippe* of Felder, but the sexes more equal in size; the black spots on both surfaces of both sexes considerably smaller, those upon the median interspaces of the primaries not quadrate on either surface; ground-colouring paler; male with the thickened sexual patch upon the first median branch very broad and prominent, and the submarginal spots isolated instead of united into a band as on the female; on the under surface also all the spots are smaller, the silvery spots less prominent, and the discal ocelloid spots of the secondaries very small and dull in colouring; the female is altogether duller, has the bases of the wings above of an altogether greener colour, with the black lines on the basal

area thicker, the submarginal pale spots whiter, the secondaries with a black spot on the radial instead of on the subcostal interspace, thus making an uninterrupted series of four spots; the apical area of primaries and the whole ground-colour of the secondaries dull olive-green; the silver spots on the primaries better formed, and those on the secondaries larger than in Yokohama females, although decidedly smaller than in Nikko females of *A. nerippe*. Expanse of wings, ♂ 3 inches, ♀ 3 inches 4 lines.

Two males, Posiette Bay, N.E. Corea; one female, Hakodaté.

The form of this species is somewhat different from that of *A. nerippe* (seven fine examples of which are before me), the wings being somewhat more elongated and the costa of primaries consequently less arched.

11. *Argynnis japonica.*

Argynnis laodice, var. *japonica*, Ménétriés, Cat. Acad. Petr. Lep. ii. p. 102, pl. x. fig. 3 (1857).

Six males, Hakodaté; six females, Posiette Bay, Corea.

12. *Argynnis laodice.*

Papilio laodice, Pallas, Reise, i. App. p. 470 (1771).

Two males and three females, Posiette Bay, N.E. Corea.

13. *Argynnis rabdia.*

Argynnis rabdia, Butler, Ann. & Mag. Nat. Hist. ser. 4, vol. xix. p. 93 (1877).

Two females, Posiette Bay, N.E. Corea.

14. *Argynnis daphne*, var. *fumida.*

Differs from the European type in its duller and more smoky colouring and larger black spots on both surfaces; it is, however, of the same size, and therefore considerably smaller than *A. rabdia*, from which it differs also in its duller coloration.

Two females, Posiette Bay, N.E. Corea.

We have the male of this form from Yesso.

15. *Brenthis Perryi*, sp. n.

♂. Allied to *B. selene*, but larger, and with all the black markings on both surfaces considerably larger and broader, more like those of *Argynnis oscarus*, the ground-colour richer (but not red as in Eversmann's figure of *A. oscarus*); the silver spots on the under surface more metallic; the apical red-brown patch of the primaries and the two large patches on the apical

and anal areas of secondaries much broader and darker Expanse of wings 1 inch 9 lines.

Posiette Bay, N.E. Corea, August.

16. *Limenitis sibilla.*

Papilio sibilla, Linnæus, Syst. Nat. 1, ii. p. 781 (1767).

Hakodaté, July.

Lycænidæ.

17. *Everes hellotia.*

Lycæna hellotia, Ménétriés, Cat. Mus. Petr. Lep. ii. p. 124, pl. x. fig. 6 (1857).

Hakodaté and Kobé, July.

18. *Lycæna ladonides.*

Lycæna ladonides, De l'Orza, Lép. Jap. p. 20 (1869).

Kobé, July; Yokohama, August.

19. *Lycæna argia.*

Lycæna argia, Ménétriés, Cat. Mus. Petr. Lep. ii. p. 125, pl. x. fig. 7 (1857).

Hakodaté and Kobé, July; Yokohama, August.

The specimens, though numerous, were for the most part much worn.

20. *Lycæna ægon.*

Lycæna ægon, Denis, Wien. Verz. p. 185 (1776).

One worn female, Posiette Bay, N.E. Corea.

21. *Lycæna lycormas.*

Polyommatus lycormas, Butler, Journ. Linn. Soc., Zool. vol. ix. p. 57 (1866).

One worn male, Yokohama, August.

22. *Niphanda fusca.*

♀. *Thecla fusca*, Bremer & Grey, Schmett. N.-China's, p. 9 (1853); Ménétriés, Cat. Mus. Petr. Lep. i. pl. iv. fig. 5 (1855).
♀. *Amblypodia fusca*, Bremer, Bull. Acad. Pét. iii. p. 469 (1861).
♂. *Amblypodia dispar*, Bremer, Lep. Ost-Sibir. p. 24, pl. iii. fig. 4 (1864).

One male, Posiette Bay, Corea.

23. *Chrysophanus timæus.*

Papilio timæus, Cramer, Pap. Exot. ii. pl. 186 E F (1779).

Hakodaté and Kobé, in July.

Papilionidæ.

Pierinæ.

24. *Terias suava.*

Terias suava, Boisduval, Sp. Gén. i. p. 670 (1836).

One male, Yokohama, in August.

A narrow-winged Chinese species.

25. *Terias Mariesii.*

Terias Mariesii, Butler, Trans. Ent. Soc. London, 1880, p. 198.

One female, Yokohama, in August.

It is singular that the rarer sex only of this species should have been obtained.

26. *Terias Hobsoni.*

Terias Hobsoni, Butler, Proc. Zool. Soc. 1880, p. 668.

Two females, taken in Yokohama in August.

This species has hitherto only been known to occur in Formosa.

27. *Colias poliographus.*

Colias poliographus, Motschulsky, Etudes Entom. ix. p. 29 (1860).

Hakodaté and Kobé, July.

28. *Colias simoda.*

Colias simoda, De l'Orza, Lép. Jap. p. 16 (1869).

Hakodaté, in July.

This *Colias* is difficult to separate from the preceding when one has a large series to examine, owing to the tendency to hybridization known to exist between close allies in this genus; typical examples of the two forms are readily recognizable. It is of course possible that *C. poliographus* and *C. simoda* may belong to one variable species; but they must be carefully reared from the egg before one can with fairness assert their identity.

29. *Ganoris crucivora.*

Pieris brassicæ, var. *crucivora*, Boisduval, Sp. Gén. i. p. 522 (1836).

A pair taken at Hakodaté in July.

30. *Ganoris dulcinea*, sp. n.

Most nearly allied to *G. megamera* of Japan, but very

distinct. Wings above milk-white, with the veins very slenderly grey, but darker towards the apical margins: primaries with slender black costal margin; the basal two fifths of the costal border irrorated with blackish scales; a pyramidal greyish-brown apical patch, divided by white internervular lines into four decreasing spots; a slightly blacker spot just beyond the middle of the second median interspace; veins at base of all the wings edged with blackish scales: body blue-black; thorax clothed with bluish-grey hairs; abdomen grey at the sides. Under surface milk-white, the wings with dusky veins: primaries with the spot upon the second median interspace nearly as above, but slightly browner; a second larger and oblique spot across the fourth fifth of the internomedian interspace; costal border slightly greyish towards the base; no apical markings: secondaries with the costal border at base slightly tinted with pale buff. Expanse of wings 2 inches 4 lines.

Posiette Bay, N.E. Corea, in August.

This species differs from all its allies in the character of the apical markings of the primaries above.

31. *Leptosia amurensis.*

Leucophasia amurensis, Ménétriés, Bull. Acad. Pét. xvii. p. 213 (1859); Schrenck's Reisen, ii. p. 15, pl. i. figs. 4, 5 (1859).

Posiette Bay, N.E. Corea, in August.

32. *Leptosia Morsei.*

Leptosia Morsei, Fenton, Proc. Zool. Soc. 1881.

♀, Hakodaté, in July.

Papilioninæ.

33. *Papilio teredon.*

Papilio teredon, Felder, Reise der Nov. Lep. i. p. 61 (1865).

Yokohama, in August.

34. *Papilio hippocrates.*

Papilio hippocrates, Felder, Verh. zool.-botan. Ges. Wien, xiv. p. 314. n. 356 (1864).

Yokohama, in August.

Hesperiidæ.

35. *Pamphila venata.*

Hesperia venata, Bremer & Grey, Schmett. N.-China's, p. 10 (1853).
Pamphila venata, Ménétriés, Cat. Mus. Petr. Lep. i. pl. v. fig. 7 (1855).

♂, Posiette Bay, Corea, and Yokohama; ♂ ♀, Hakodaté.

36. *Pamphila sylvatica.*

Pamphila sylvatica, Bremer, Bull. Acad. Pét. iii. p. 474 (1861); Lep. Ost-Sibir. p. 34, pl. iii. fig. 10 (1864).

Posiette Bay, Corea.

Heterocera.

Chalcosiidæ.

37. *Pidorus atratus.*

Pidorus atratus, Butler, Ann. & Mag. Nat. Hist. ser. 4, vol. xx. p. 402 (1877); Ill. Typ. Lep. Het. ii. p. 9, pl. xxiii. fig. 9 (1878).

Yokohama, in August.

Lithosiidæ.

38. *Setina micans.*

Setina micans, Bremer & Grey, Schmett. N.-China's, p. 15 (1853).

Posiette Bay, N.E. Corea.

The description by Bremer does not give a good idea of the general colouring of the upper surface; he speaks of it thus, "Corpore et alis ex flavo albido-micantibus," and later on as "shining yellowish white," whereas the primaries are shining white, with pale buff borders, and the secondaries pale buff; the thorax is also white; the head, collar, and abdomen buff. Notwithstanding this incorrect or, at least, imperfect description of the ground-colour, every thing else in the description is so exact that I cannot doubt that the species before me is Bremer's insect. We have a large female ($1\frac{3}{4}$ inch in expanse) from Pekin.

III.—*On certain remarkable Modifications of the Avicularium in a Species of Polyzoon; and on the Relation of the Vibraculum to the Avicularium.* By the Rev. Thomas Hincks, B.A., F.R.S.

The homology between the curious avicularian appendage which is present on so many of the Cheilostomata and the

zoœcium with its contained zooid has been amply demonstrated and is now generally admitted. Indeed the rudimentary or primary forms of the organ exhibit so slight an amount of divergence from the ordinary cells, that we have no difficulty in recognizing the morphological relationship between the two; and from this starting-point a series of transitional forms conducts us to the most highly specialized term, in which the zoœcial type is effectually masked. The true "bird's-head," with its elaborate prehensile apparatus, its delicate tactile organ, and its half-rhythmical movement, is confined to a few genera; but between it and the earliest stage of the transformation (a slight modification of the oral valve) is interposed a multitude of forms, exhibiting a wonderful variety of structure, and discharging the important function of defence in many diverse ways. The morphological line which leads up to the articulated and movable "bird's-head" is flanked by a host of branch lines, in which the development assumes many directions and culminates in very different structures. In a large proportion of these structures the prehensile faculty is very feebly manifested, if at all. The mandibular portion, which is the representative of the oral valve of the cell, is little fitted to seize intruders or to hold them in its grasp. In very many cases the hooked extremity, which distinguishes the "bird's-head" is altogether absent; the mandible is rounded or spatulate, and works more like the lid of a box than as a seizing-organ. In such cases the defensive action must be limited, it would seem, to the opening and closing of the mandible, which may have a deterrent effect on unwelcome visitors. As the appendages are often developed in immense numbers over the colony, it is quite conceivable that the safety and comfort of the polypides may be largely promoted by their movements.

On the other hand, where only a single avicularium is present (as often happens), or the size is very diminutive, and the action of the mandible proportionately feeble and inconspicuous, it is difficult to understand what useful office it can discharge.

In a considerable number of cases the mandible assumes a form which is still less compatible with any prehensile function. The pointed extremity is more or less elongated into a spine-like process, which projects beyond the fixed beak on which the movable jaw works. In some species (e. g. *Schizoporella vulgaris*, Moll) this modification is carried to a great extent, and the result is a long and slender setiform appendage, which may help, as it sways to and fro, to keep off creatures or substances that would be injurious to the polypide. Occa-

sionally this structure is varied by the development of a chitinous expansion along each side of the spine, by which it is converted into a kind of flapper.

The avicularium with more or less elongated mandible is a step towards the second of the appendicular organs with which the Cheilostomatous Polyzoa are furnished, the *vibraculum.* The latter, in its most highly specialized form, is the terminus of one of the branch lines before referred to. There can be no reasonable doubt that it is a derivative from the avicularium, and not an independent modification of the oral valve of the zoœcium*; for the steps by which the one appendage passes into the other are easily traceable. The observations which I am about to record crown the evidence, by exhibiting within the history of a single species the leading stages of the transformation. They also illustrate in a very striking way the instability of avicularian structure, and the liability to variation which is one of its chief characteristics.

The criterion by which it has been proposed to distinguish the vibraculum from the avicularium (the absence of a beak) is, of course, a purely arbitrary one; for the mandible takes on the specifically vibracular function before the beak has vanished. In the highest form of vibraculum the beak is retained, but is so modified as to supply a deep terminal notch or cleft, in which the seta is suspended without hindrance to the freedom of its play. In this form the function is most specific and is clearly defined; planted close to the orifice of the cell, its seta sweeps energetically at intervals over the front and dorsal surfaces, and helps to secure freedom of egress and action to the polypide.

I come now to the observations which it is the chief object of this paper to record.

Amongst the species in which the avicularium is furnished with an elongated mandible is the ubiquitous *Microporella ciliata*, Pallas, which has well nigh accommodated itself to all climes and circumstances. It exhibits, however, this peculiarity, that the condition is not constant: in some cases the avicularium is of the ordinary type (woodcut, fig. 1); in others the mandible is more or less prolonged into a straight and slender spine (woodcut, fig. 2). The prolongation is usually moderate; and, so far as hitherto observed, it is an extension merely, without any further modification.

Fig. 1.

* Darwin, 'Origin of Species,' 6th edit. p. 194.

But in specimens from the Queen Charlotte Islands, which have been placed in my hands by Dr. G. M. Dawson, of the Canadian Geological Survey, the appendage occurs in a very different guise: so far as the mandibular portion is concerned, its appearance is completely changed, and it is at once evident that a very important structural modification has been effected. The mandible has altogether lost its lid-like character, and is now a very tall membrano-chitinous appendage, commonly exceeding in length the entire cell, broad at the base, and tapering off to a fine point above, where it is slightly curved (woodcut, fig. 3). The expanded triangular portion below, which represents the normal mandible, has undergone little change; but its office now is to support the vibraculoid appendage which I have described. Just above the point where the extremity of the true mandible begins to expand into the *quasi*-vibraculum, there are two small spinous projections; these mark the commencement of a marginal extension of the vibraculum, which runs along each side from this point to the apex, diminishing in width as it approaches the top. This marginal increment curls upward, and gives a channelled appearance to the appendage. The whole structure is of a membranaceous character; and there is always a slight twist near the base of it. When the transformed mandible is at rest on the fixed beak, the free portion of it occupies a suberect position.

Fig. 2.

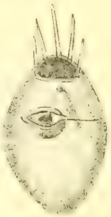


Fig. 3.

The modification is not confined in this case to the mandible, but extends to other elements of the structure. In the first place, the rising on which the organ is placed is much larger and more prominent than in the normal form, and recalls the vibracular cell which supports the movable seta in *Mastigophora Hyndmanni*. The beak also has undergone a change which, though slight in itself, is significant.

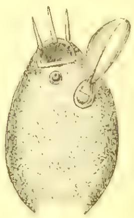
The anterior extremity, which in the normal condition is directed straight outwards, running to a point, is here more or less notched, and we have a distinct suggestion of the vibracular cleft in which the seta of the more highly specialized

forms is suspended. This modification, which is very slight in degree, secures to a corresponding extent a freer range of movement.

In this remarkable variety, then, the avicularium of the normal *M. ciliata* is replaced by a well-developed organ with vibracular function, which has made a considerable advance towards the structure of the most specialized vibracula. Placed as they are on the summit of a considerable rising, at a short distance below the orifice, the tall setæ command the whole of the oral tract; and their vigorous sweep must do much to prevent the accumulation of noxious matter within its bounds.

It should be mentioned that the ordinary forms of the species also occur somewhat abundantly on shells from the Queen Charlotte Islands. Another interesting modification occurs in the same species. On a large colony, obtained by Capt. Cawne Warren, probably from the coast of Ceylon or from Bass's Straits, the avicularium is furnished with the spinous prolongation of the mandible, and along each side of the spine a delicate membranous expansion is developed (woodcut, fig. 4), which completely alters its appearance and fits it for a new function or for the discharge of the old one in a different way. The avicularian jaws and the vibracular setæ are replaced in this variety by the *flapper*; and these varied modifications are embraced within the life-history of a single species.

Fig. 4.



We are already acquainted with the changes which occur in the radical fibres of the Polyzoa correspondent with diversities of habitat. When the sponge or other soft substance is the site of the colony, they develop a system of hooks, to act as grapnels; when the smooth, tough frond of the seaweed, they elaborate adhesive disks for attachment. It would seem that a like ready adaptability to changes of circumstance is also characteristic of the avicularian appendages.

These observations, besides their morphological interest as throwing a clear light on the genealogy of the vibraculum, bring out very forcibly the instability of avicularian structure, to which I have already referred; and in the presence of such facts as I have now adduced and others like them, I find myself unable to agree with those who assign a high value to the appendicular organs for purposes of classification.

Summary.

In the Polyzoon *Microporella ciliata*, Pallas, the following forms of the avicularian organ occur:—

1. Ordinary avicularium with pointed beak.
2. Avicularium with the mandible elongated into a spine.
3. Avicularium with the spinous mandible supporting a membranous flapper.
4. Vibraculoid structure with tall, well-developed seta and partially-modified beak.

IV.—*Notes on Coleoptera, with Descriptions of new Genera and Species**.—Part IV. By Francis P. Pascoe, F.L.S. &c.

Most of the species described below have been in my collection for many years. Haag-Rutenberg and Mr. F. Bates have during the time published many genera and species of Tenebrionidæ; but as the former is no longer amongst us and the latter has given up the study, I have resumed the task of making known some of the many unpublished forms in my possession; and to them I have added a few from other groups. Drs. Horn and Leconte have given us excellent accounts of the United-States species; but they sternly refuse to look at any other forms than their own. Dr. Horn finds fault with some of us for not studying the American species: but we cannot procure them; collections from the United States rarely or never come into the market; and American entomologists do not seem to care for any thing outside the States.

In this and former papers I have designedly avoided all recondite characters; they are often only to be obtained by dissection, involving perhaps the destruction of the specimen; and too often, to avoid this, characters which are found in one are *assumed* to exist in their near allies. To give a ready clue to the name of the species is, I consider, the great object of descriptions.

List of Genera and Species.

COLYDIIDÆ.

Gempylodes superans.

EUCNEMIDÆ.

Hylotastes terminatus.

ANTHRIBIDÆ.

Doticus (*n. g.*) palmaris.

TENEBRIONIDÆ.

Opatrinæ.

Apostethus (*n. g.*) terrenus.

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* For Part III., see 'Annals,' 1875, xv. p. 59.

HELOPINÆ.

Blepegenes equestris.
Telethrus (*n. g.*) ebeninus.

Espites (*n. g.*) basalis.
Diopethes (*n. g.*) arachnoides.
Immedia (*n. g.*) occulta.
Exapinæus (*n. g.*) politus.

HELOPININÆ.

Micrantereus tentyrioides.

STRONGYLIINÆ.

Alcyonotus (*n. g.*) iridescens.

CNODALONINÆ.

Camaria chlorizans.
—— clandestina.
—— decipiens.
Calydonis (*n. g.*) refulgens.
—— cuprea.

CISTELIDÆ.

Prostenus militaris.
—— iocerus.
—— parilis.
—— nitens.
—— lugubris.

Gempylodes superans.

G. fuscus, lateribus capitis ante oculos vix elevatis; antennis articulis ultimis modice transversis. Long. $5\frac{1}{2}$ lin.

Hab. Siam.

Dark dullish brown; head irregularly punctured, grooved on each side before the eyes; antennæ with the seventh to the tenth joints transverse and slightly moniliform, last joint oblong-ovate, as long as the three preceding together; prothorax less than twice as long as broad, finely punctured, with a narrow but deep longitudinal groove; elytra nearly four times as long as broad, coarsely punctured, the alternate intervals strongly ribbed; abdomino-intercoxal process triangular; metasternum longitudinally grooved; abdominal segments finely punctured.

Gempylodes (*Gempylus*, Cuv. & Val., a genus of elongate-bodied fishes), described by me in the 'Journal of Entomology' (ii. p. 132), was compared to *Mecedanum*, Er., unknown to me at that time, except from the author's short generic description, but which Prof. Westwood afterwards identified with Guérin's previously described *Aprostoma*, which that writer strangely referred to the Brenthidæ. *Aprostoma* is remarkable, *inter alia*, for its long tarsi, due principally to the basal joint.

Hylotastes terminatus.

H. niger, prothorace (medio antice lateribusque exceptis) et elytris (parte posteriore tertia excepta) miniaceis. Long. 6 lin.

Hab. Borneo (Sarawak).

Narrowly elongate, sides nearly parallel; head black, closely punctured; antennæ black, third and following joints to the tenth triangular, compressed, the last oblong and subtrifid at the apex; prothorax not quite so long as broad,

miniaceous, an anterior triangular spot and sides black; scutellum rounded behind; elytra nearly four times as long as broad and rather narrower than the prothorax, miniaceous (except the apical third), each with five raised lines, the intervals gently concave; body beneath and legs dull black; intermediate and posterior tarsi longer than their tibiæ.

This handsome species is covered with a dense silky pile; *H. formosus*, de Bouv., the nearest ally of the few described species, has flabellate antennæ (perhaps a sexual character), a more transverse prothorax, and the elytra violet-black, except at the (reddish) base.

Doticus.

Rostrum breve, transversum; *antennæ* infra oculos insertæ, breviusculæ, articulis duobus basalibus incrassatis, tertio ad sextum tenuibus, gradatim brevioribus, tribus ultimis clavam formantibus. *Oculi* rotundati. *Prothorax* transversus, postice latior, carina basali ad latera abbreviata. *Elytra* brevia, basi elevata. *Pedes* antici elongati; *tarsi* articulis duobus basalibus dilatatis, tertio perbrevi, profunde bilobo; *pedes* intermedii et postici breviusculi; *coxæ* anticæ fere contiguæ.

Allied to *Aræocerus*, in all the characters of which it nearly agrees; but the remarkable length of the anterior legs with the broad basal and second joints of their tarsi, and the third joint very short and deeply embayed in the second, forbid its location in that genus.

Doticus palmaris.

D. breviusculus, fuscus, squamulis piliformibus griseis tectus; elytris basi nodosis. Long. 3 lin.

Hab. Queensland (Wide Bay).

Rather short, dark brown, covered with greyish hair-like scales; head flattish between the eyes, slightly convex behind; eyes close to the prothorax; antennæ not longer than the head and prothorax together, testaceous, the last three joints blackish, except at the base; prothorax nearly twice as broad at the base as at the apex; elytra as broad as the prothorax at the base, narrowing slightly towards the apex, which is somewhat obtuse, striate, the alternate interstices slightly raised, the second and third forming together a well-marked elevation at the base; third and fourth abdominal segments narrowed in the middle.

Apostethus.

Caput transversum; *clypeus* apice rotundatus, a capite discretus; *labrum* quadratum, productum; *antennæ* apicem versus crassiores.

articulo tertio elongato, 6°-10^{m} moniliformibus. *Oculi* angusti. *Prothorax* transversus, utrinque rotundatus, apice emarginatus. *Elytra* breviter ovata, angulis anticis rotundatis; *epipleura* integra. *Pedes* subtenues; *tibiæ* curvatæ, compressæ; *tarsi* breves. *Prosternum* elevatum, furcatum. *Metasternum* brevissimum. *Coxæ* posticæ subapproximatæ.

From *Opatrum* this genus differs in its prominent labrum, forked prosternum, and extremely short metasternum. *Achora** has a narrow clypeus, emarginate at the apex and hiding the labrum, straight tibiæ, and prosternum elevated but not forked.

Apostethus terrenus.

A. obovatus, fuscus, indumento terreno indutus; antennis extus pedibusque fulvescentibus. Long. $4\frac{1}{2}$ lin.

Hab. Queensland (Port Bowen).

Obovate, moderately convex, brown, and covered by an earthy squamulose crust; head closely punctured, a deep curved groove separating the clypeus from it; antennæ fulvous towards the tip, the first joint only partially covered by the supraorbital ridge, the third joint as long as the two following together, last joint broadly ovate, pointed; prothorax rather dilated at the sides, rugosely punctured, the disk with three longitudinal impressions, anterior angles acute, slightly produced; scutellum small, transversely triangular; elytra about a third longer than broad, sulcate-punctate, each puncture bearing a short seta.

Blepegenes equestris.

B. oblongus, nitide cupreus; capite prothoraceque muticis, hoc modice convexo, haud transverso, utrinque angulato. Long. 11 lin.

Hab. New South Wales (Bellinger River).

Oblong, glossy copper; head unarmed, impunctate, a V-shaped impression between the eyes; neck black, granulate; antennæ with the third joint longest, the following (except the shorter fourth) subequal; prothorax impunctate, moderately convex, nearly as long as broad, the sides forming a broad angle; scutellum small, transverse; elytra elliptic, rather flattish on the disk, striate, interstices at the sides slightly raised.

Notwithstanding the marked dissimilarity of the species

* *Achora* is synonymous with *Prionotus*, Muls., a name used long before by Cuvier for a genus of fishes and by Laporte for a genus of Hemiptera.

from *B. aruspex* (the only exponent of the genus at present), I can find no character sufficient to warrant its separation, unless the remarkable armature of the head and prothorax of the latter be considered of generic importance. I had, however, at one time thought of proposing for it the generic name of *Metriogonus*.

Telethrus.

Caput transversum, pone oculos haud constrictum; *clypeus* subproductus, a capite sulco discretus; *labrum* parvum; *antennæ* modice elongatæ, articulis tertio quartoque æqualibus, sequentibus plus minusve triangularibus, ultimo ovato. *Prothorax* rotundatus, convexus. *Scutellum* nullum. *Elytra* breviuscula, basi prothoracis haud latiora; *epipleura* angusta. *Pedes* mediocres; *tibiæ* rectæ, anticæ intus (apicem versus) dente unico instructæ; *tarsi* breviusculi, antici articulis quatuor basalibus transversis, arcte applicatis. *Metasternum* brevissimum; *mesosternum* paulo excavatum. *Processus* intercoxalis latus, apice truncatus.

I place this genus near *Misolampus* principally on account of the absence of a scutellum; in the broad abdomino-intercoxal process it agrees with *Sphærotus* and *Osdara*. The epipleuræ are not distinctly marked off from the elytra.

Telethrus ebeninus.

T. niger, nitidus; capite prothoraceque impunctatis; elytris striatis. Long. 5 lin.

Hab. Pará * (Santarem).

Glossy black, especially the legs; head and prothorax impunctate, the latter very convex, and about as broad as long, the anterior half the largest; pronotum marked off from the flanks by a slender raised line; elytra not much longer than broad, very convex, slightly tapering near the apex, punctate-striate, the striæ sharply defined, the punctures strongly impressed and impinging on the interstices.

Micrantereus tentyrioides.

M. anguste ovatus, niger; prothorace confertim punctato; elytris irregulariter et leviter tuberculatis; femoribus intermediis dente parvo instructis. Long. $5\frac{1}{2}$ lin.

Hab. Arabia (Yemen).

Narrowly ovate, black, scarcely shining; head and pro-

* Not always certain of the exact localities of many of the species, I have used the name Pará for the lower province and Amazons for the upper, the two great political divisions at present of the Amazons-valley region.

thorax closely punctured, the latter rather broader than long; scutellum very transverse; elytra crowded with small irregular tubercles, having more or less a reticulate character, the intervals punctured; intermediate femora with a small tooth towards the apex; tarsi moderately elongate.

Of the described species, this comes nearest to the Senegal *M. anomalus*, Guér., but is much narrower (resembling in outline a *Tentyria*) and far less strongly and more closely tuberculate. It is at present the only Asiatic representative of the genus.

Camaria chlorizans.

C. oblonga, viridi-metallica, femoribus tibiisque cupreis; antennis nigrescentibus; elytris striatis. Long. 6 lin.

Hab. Pará (Santarem).

Oblong, metallic green; femora and tibiæ coppery; tarsi, except at the claw-joint, bluish black; antennæ blackish, the last five joints oblong, dilated; prothorax transverse, finely punctured, well rounded at the anterior angles; scutellum scutiform, yellowish; elytra striated, the striæ indistinctly punctured.

In its coloration this species seems to be very distinct.

Camaria clandestina.

C. sat anguste oblonga, cuprea, prothorace transverso, lateribus parallelis, angulis anticis obtuse rotundatis; elytris striatis. Long. 8 lin.

Hab. Pará (Santarem).

Rather narrowly oblong, coppery; head between the eyes, including the clypeus, triangularly depressed, the triangle at the sides bounded by a raised line; antennæ blackish, the terminal joints slightly thickened; prothorax transverse, parallel at the sides, the anterior angles obtusely rounded, finely punctured, and dotted with pale purplish spots; elytra striated, striæ with indistinct oblong punctures; intermediate and posterior tarsi elongate.

This species may be placed near *C. nitida*; it is remarkable for the sculpture of the head.

Camaria decipiens.

C. oblonga, cuprea; prothorace modice transverso, lateribus paulo angulisque anticis gradatim rotundatis; elytris striatis. Long. 8 lin.

Hab. Pará (Santarem).

In general appearance similar to the preceding; but the

flat triangular space between the eyes is not bounded by a raised line, the eyes are more widely apart, owing to the greater breadth of the head, the antennæ have the seventh to the tenth joints transverse, the prothorax larger, with its sides gradually rounded from near the base, giving less prominence to the anterior angles, and the striæ on the elytra more distinctly punctured. The intermediate and posterior tarsi are also shorter.

CALYDONIS.

Caput exsertum, transversum; *clypeus* a capite haud discretus, apice integer; *labrum* breve; *antennæ* breviusculæ, gradatim crassiores. *Prothorax* transversus, lateribus fortiter marginatis. *Elytra* oblonga, apice integra. *Pedes* subelongati; *femora* haud clavata; *tibiæ* vix curvatæ; *tarsi* subtus dense pilosi, anteriores articulis tribus basalibus transversis, ultimo elongato, infra canaliculato. *Processus* abdomino-intercoxalis triangularis; *mesosternum* antice V-formi excavatum.

This genus is allied to *Camaria*, but is differentiated by its short clypeus not marked off from the head, and by the transverse terminal joints of the antennæ, which are consequently much shorter. The elytra are not striated as in *Camaria*, and are more parallel at the sides.

In the two species described below the tarsi are clothed beneath with a dense silky ochreous pile.

Calydonis refulgens.

C. oblonga, læte purpureo et viridi varians, antennis tarsisque nigris; articulis tertio quartoque antennarum brevibus, longitudine æqualibus. Long. 8–9 lin.

Hab. Amazons, Pará.

Oblong, brilliant metallic purple and green, varying according to the light; head finely punctured, depressed below the eyes, which in certain positions show spots of rich purple; antennæ black, third and fourth joints oblong, the rest, except the last, transverse, all the joints coarsely punctured; prothorax much narrower behind, finely punctured; scutellum scutiform; elytra finely seriate-punctate; last joint of the intermediate tarsi shorter than the rest together.

Calydonis cuprea.

C. oblonga, cupreo-metallica; capite antice haud depresso; articulis tertio quartoque magis elongatis. Long. 9 lin.

Hab. Pará.

Oblong, glossy metallic copper; head finely punctured, not depressed in front; clypeus impunctate; antennæ dark brown, moderately punctured, third and fourth joints oblong, equal, the rest, except the last, transverse; prothorax much narrower behind, finely punctured; scutellum scutiform; elytra finely seriate-punctate; last joint of the intermediate tarsi nearly as long as the rest together.

In this species the prothorax is more transverse and is more obtusely rounded at its anterior angles.

Espites.

Caput transversum, fere ad oculos inclusum; *clypeus* productus, apicem versus angustior, a capite sulco arcuato notatus; *labrum* breve; *palpi* maxillares articulo ultimo subtriangulari; *antennæ* breviusculæ, extus gradatim crassiores, articulo tertio longiore, 7°–10m transverse triangularibus, ultimo breviter ovato. *Prothorax* transversus, apice vix emarginatus, basi bisinuatus, lateribus bene marginatus, angulis posticis acutis. *Elytra* oblonga, quam prothorax paulo latiora; *epipleura* angusta. *Pedes* sat breves, *tibiæ* sublineares; *tarsi* breves, robusti. *Prosternum* productum; *mesosternum* declive; *metasternum* elongatum. *Processus* intercoxalis subtriangularis, apice rotundatus.

This genus appears to be allied to *Chariotheca*, but differentiated, *inter alia*, by its sloping mesosternum, short stout tarsi, and narrower clypeus. I have adopted Mr. F. Bates's name (MS.).

Espites basalis.

E. oblongo-ovalis; capite, prothorace pedibusque cæruleis; elytris colore variantibus, basi aureis, postice et ad suturam violaceis, medio purpureis; corpore infra nigrescente. Long. 3 lin.

Hab. New Guinea (Saylee).

Oblong ovate; head and prothorax shining light blue, the latter impunctate, its length more than half its breadth; scutellum triangular, blue; elytra varying in colour according to the light, but very brilliant, the base gold changing to coppery gold, the suture and sides posteriorly steel-blue varying to green, the middle and apex purple; antennæ dark brown or blackish; body beneath glossy black.

Diopethes.

Caput postice constrictum, in medio gibbosum; *clypeus* latissimus, haud productus, antice rectus, a capite indistincte discretus; *labrum* breve. *Antennæ* breviusculæ, articulis quinque ultimis transversis, ultimo apice late triangulari. *Prothorax* transversus, apice late emarginatus, postice angustior. *Elytra* subglobosa,

prothorace multo latiora; *epipleura* angusta, vix inflecta. *Pedes* mediocres; *tibiæ* arcuatæ; *tarsi* breves, lineares. *Mesosternum* leviter excavatum. *Processus* abdomino-intercoxalis triangularis.

This remarkable form (the globose elytra, with its closely applied scutellum, rising high above the prothorax) perhaps finds its nearest ally in *Sphærotus*, from which it may be distinguished, *inter alia*, by its narrow intercoxal process and short tarsi. So far as I can make out from the parts *in situ*, the jugulum is broad, not showing much of the maxillæ, while the mentum is partially received into an emargination of its anterior border.

Diopethes arachnoides.

D. breviter ovatus, vix nitidus, fuscus; prothorace lævigato; elytris valde elevatis, grosse seriatim punctatis. Long. $2\frac{3}{4}$ lin.

Hab. Bahia.

Shortly ovate, the comparatively small transverse prothorax much narrower than the globular elytra, which are abruptly and considerably elevated, together with the scutellum, above the former; antennæ a little longer than the head, rufous-brown, the first four joints not varying much in length, the ninth and tenth very transverse, the last semicircular; head slightly punctured; prothorax narrower at the base, the pronotum separated from the flanks by a very slightly raised line; each elytron with about eight rows of large punctures, the intervals considerably raised; claw-joint of all the tarsi longer than the preceding together.

IMMEDIA.

Caput transversum, paulo exsertum; *clypeus* breviter emarginatus, a capite vix discretus; *labrum* transversum, integrum; *labium* parvum, cordiforme. *Antennæ* articulis 9° et 10° transversis. *Prothorax* transversus. *Elytra* rotundata, elevata; *epipleura* latissima. *Metasternum* brevissimum. Cæteris ut in *Cyrtosoma*.

In its rounded form the exponent of this genus is more nearly allied to *Cyrtosoma* among Cnodaloninæ (to which it must be referred on account of its short metasternum) than to the elongate forms of the Helopinæ. It may be the *Cnodalon minutum* of Dejean's catalogue, mentioned by Lacordaire when treating of *Cyrtosoma*.

Immedia occulta.

I. rotundata, valde convexa cuprea; elytris purpuratis, punctatis, punctis annulo viridi-metallico circumdatis. Long. 2 lin.

Hab. Bahia.

Rounded, very convex, copper-brown; elytra dark purple, seriate-punctate, each puncture sublinear and surrounded by a metallic-green ring; head moderately punctured, an impressed line at the base of the antennary rings; antennæ gradually thicker, the third joint about half as long again as the fourth, the third triangular, ninth and tenth very transverse, the last rounded; prothorax very short, sparingly punctured; scutellum triangular; elytra nearly as broad as long, epipleura very broad at the base, gradually narrower to the apex, seriate-punctate, each puncture surrounded with a greenish metallic ring (not noticeable without the aid of a lens); claw-joint nearly as long as (posterior tarsi) or longer than the preceding joints together.

Exapinæus.

Caput retractum, transversum; *clypeus* apice integer, a capite indistincte discretus; *labrum* breve; *mentum* subquadratum; *labium* cordiforme; *antennæ* verisimiliter apicem versus crassiores, sed articuli terminales quatuor desunt. *Prothorax* transversus, apice emarginatus. *Elytra* prothorace haud latiora, convexa. *Pedes* mediocres; *tibiæ* intermediæ arcuatæ; *tarsi* anteriores articulo basali rotundato et valde ampliato. *Processus* abdomino-intercoxalis triangularis. *Mesosternum* V-formi excavatum.

This appears to me to be quite an isolated genus which perhaps may be best placed after *Tetraphyllus*. The remarkably dilated basal joint of the anterior tarsi is possibly only a sexual character. Beyond the above diagnosis the other characters agree with the Cnodaloninæ as defined by Lacordaire.

Exapinæus politus.

E. late obovatus, nitide fulvo-castaneus; capite prothoraceque subtilissime punctatis; elytris seriatim minute punctatis. Long. 6 lin.

Hab. Amazons.

Broadly obovate, yellowish chestnut, highly polished; the suture and base of the elytra a trifle paler, beneath darker; head rather small, moderately transverse; third joint of the antennæ nearly three times as long as the second, the fourth to the seventh elongate triangular, dark brown (the first three fulvous); prothorax more than twice as broad as long, very minutely punctured; scutellum small, triangular; elytra about a half longer than broad, with rows of minute punctures; fore tibiæ slightly curved, hind tibiæ straight.

ALCYONOTUS.

Caput transversum, exsertum; *clypeus* a capite haud discretus, apice subemarginatus; *labrum* parvum; *antennæ* breves, articulis 1^{o}–5^{m} oblongis, 6^{o}–10^{m} transversim dilatatis, ultimo oblongo-rotundato. *Pronotum* subquadratum, a pleura linea elevata separatum. *Elytra* elongata; *epipleura* angusta. *Prosternum* elevatum; *mesosternum* antice excisum. *Processus* abdomino-intercoxalis anguste triangularis. *Femora* haud clavata; *tibiæ* breves, quatuor anteriores arcuatæ; *tarsi* infra dense pilosi, antici et intermedii articulis (ultimo excepto) transversis; *unguiculis* dentatis.

Camarimena, to which this genus may be approximated, is at once differentiated by the absence of a well-defined line separating the pronotum from the flanks of the prothorax. Mäklin says of the pronotum, "a pleuris interdum costa latiori separatum;" but in the only reliable species (*C. variabilis*) the separation is only marked by a slight angle.

Alcyonotus iridescens.

A. elongatus, subcylindricus, nitide niger; elytris viridi-purpurascentibus; femoribus in medio fulvis. Long. 9 lin.

Hab. Cape-Coast Castle.

Elongate, subcylindrical, glossy black; elytra greenish purple, varying according to the light; femora fulvous, apex and base black; head finely punctured; antennæ brownish towards the tip, the last five joints pubescent; prothorax longer than broad, the sides nearly parallel, the anterior angles rounded, very finely punctured; scutellum scutiform; elytra more than twice as long as broad, slightly rounded at the sides, minutely seriate-punctate, the intervals smooth, but with scattered very minute punctures; beneath very glossy black, the abdominal segments slightly striated longitudinally; all the joints of the anterior and intermediate tarsi, except the last, broadly dilated.

Prostenus militaris.

P. niger, opacus; elytris coccineis; metasterno abdomineque chalybeatis. Long. 5 lin.

Hab. Amazons.

Head, antennæ, prothorax, and legs deep black and opaque; elytra rich scarlet; metasternum and abdomen glossy steel-blue, short erect black hairs scattered over the body; joints of the antennæ to the eighth inclusive gradually dilated; prothorax transverse, well-rounded at the sides, obsoletely punctured; scutellum cordiform, black; elytra with broad and shallow striæ not visible without a lens.

No other described species is allied to this in colour. My specimens are from Ega, and, like others from the Amazons district, were collected by Mr. Bates, F.R.S.

Prostenus iocerus.

P. supra viridescenti-niger, infra pedibusque chalybeatis; antennis violaceis; prothorace transverso. Long. $5\frac{1}{2}$ lin.

Hab. Pará.

Above greenish or bluish black, beneath and legs steel-blue, antennæ violet; head rather sparingly punctured; prothorax transverse, well rounded at the sides, closely and minutely punctured; scutellum triangular; elytra finely seriate-punctate, not striated; antennæ with the eighth, ninth, and tenth joints broadest.

The prothorax is transverse as in the preceding and in *P. periscelis*, Perty, but differs from both in coloration, and structurally from the latter in the less dilated antennæ.

Prostenus parilis.

P. supra cyaneo-niger, infra pedibusque chalybeatis; antennis violaceis; prothorace angustiore, paulo longiore quam latiore. Long. $5\frac{1}{2}$ lin.

Hab. Amazons.

Above dark bluish black, beneath and legs steel-blue; antennæ violet; head closely punctured; prothorax rather longer than broad, slightly incurved at the sides near the base, minutely and very closely punctured; scutellum scutiform; elytra finely seriate-punctate; antennæ with the eighth, ninth, and tenth joints broadest, the seventh slightly dilated; intermediate and posterior femora strongly clavate.

Allied to the preceding, but prothorax oblong, not transverse, and the intermediate and posterior femora strongly clavate.

Prostenus nitens.

P. angustior, nitide fuscus; elytris nitidissime cupreo-fuscis; antennis violaceis. Long. $4\frac{1}{2}$ lin.

Hab. Amazons (Ega).

Narrower, glossy brown, except the antennæ and elytra; the former violet, as long as the body, all the joints from the second flattened and gradually dilated to the ninth and tenth; prothorax narrow, longer than broad; elytra very glossy copper-brown, depressed on the basal half and towards the suture concave, finely seriate-punctate; femora moderately clavate; tarsi elongate, slender.

A very distinct species.

Prostenus lugubris.

P. sat obscure niger, corpore infra pedibusque chalybeato-violaceis, illo fortiter punctato; prothorace valde transverso. Long. 5 lin.

Hab. Brazil (Morro Velho).

Black, rather opaque, body beneath and legs dark violet; head closely punctured; prothorax much broader than long, very closely punctured, each puncture with a small white scale at the base; scutellum cordiform; elytra minutely seriate-punctate, gradually broader posteriorly; antennæ black, coarsely punctured, the joints only moderately dilated, eighth, ninth, and tenth the most dilated; femora moderately clavate.

In outline and general appearance this species may be approximated to *P. periscelis*, but, *inter alia*, is at once distinguished by its broad prothorax.

V.—*Summary Report upon a Zoological Exploration made in the Mediterranean and the Atlantic on board the 'Travailleur.'* By M. A. Milne-Edwards *.

Furnished with every thing necessary for scientific investigations, the 'Travailleur' quitted Rochefort on the 9th June last, and only returned there on the 19th August. During these seventy days of navigation, in which we traversed more than 2000 sea-leagues, we were in harbour only for the time strictly necessary for taking in coals and provisions at Cadiz, Marseilles, Villafranca, Ajaccio, Oran, Tangier, Lisbon, and Ferrol. All our time was employed in making soundings and dredgings; but we shall refer in the first place only to those executed in the Mediterranean, afterwards taking up those of the Atlantic.

The first methodical investigations made at a considerable depth in the Mediterranean date from 1841, and are due to the naturalist Edward Forbes, who confined them to the Ægean, and did not get below a depth of 300 metres. In 1870 the 'Porcupine' only dredged upon the north coast of Africa; in 1875 M. Marion, off Marseilles, could not investigate the sea beyond 350 metres; and thus the greatest depths remained almost unexplored; and it was to their study that we devoted a part of the month of June and the whole of July.

* Translated by W. S. Dallas, F.L.S., from the 'Comptes Rendus,' 28th November and 5th December 1881, pp. 876 and 931.

In this way we accumulated rich collections, which were immediately submitted to investigation.

M. L. Vaillant undertook the examination of the Fishes and Sponges; M. E. Perrier took charge of the Echinoderms; M. Marion of all the other zoophytes and the Annelids; M. P. Fischer of the Mollusca; Dr. Jullien of the Bryozoa; M. Terquem of the Ostracoda; M. de Folin and M. Schlumberger of the Foraminifera and the Radiolaria; and M. Certes of the Infusoria and some other Protozoa. I reserved to myself the investigation of the Crustacea. M. Stanislas Meunier has determined some of the rocks torn by the dredge from the bed of the sea; and, finally, M. Périer, Professor in the School of Medicine and Pharmacy at Bordeaux, is to analyze the samples of the bottom. In the summary report, which I now lay before the Academy, I merely indicate the results obtained by the naturalists whose names I have just mentioned; it will therefore be easy to recognize the part that belongs to each of them.

As was the case last year, our dredgings only furnished us with a few fishes. At depths not exceeding 450 metres we took some Gobies, *Phycis mediterranea*, and several specimens of *Plagusia lactea*, a very rare species of Pleuronectidæ; finally, at a distance of a few miles from Marseilles, at a depth of 1068 metres, the tangles brought up *Argyropelecus hemigymnus*.

A great number of Crustaceans which were known only from the Atlantic also inhabit the abysses of the Mediterranean. We have ascertained the existence there of *Lispognathus* (*Dorynchus*) *Thomsoni*, Norman, which is so abundant in the Bay of Biscay; of the *Geryon* which we had previously captured in the submarine valley of the north of Spain, which must be distinguished from the Norwegian *Geryon tridens*, and to which we have given the name of *Geryon longipes*; and of *Ebalia nux*, Norman; *Cymonomus* (*Ethusa*) *granulatus*, Norman; *Munida tenuimana*, Sars; *Calocaris Macandræi*, Bell; and *Lophogaster typicus*, Sars. Off Toulon, at 455 metres, we captured two new Oxyrhynchi, one of them belonging to the genus *Heterocrypta* of Stimpson (*Heterocrypta Marionis*, A. M.-E.), which previously included only three species, two belonging to America, and the third to Senegambia. The second is not very far from *Amathia*; we have called it *Ergasticus Clouei*, to commemorate at once the name of our ship * and that of Admiral Cloué, whose cooperation was most useful to our expedition.

* From ἐργαστικός, laborious.

At the same depth, off Planier, we obtained a new species of the genus *Galathodes*, so abundantly represented in the great depths of West-Indian sea, and the existence of which in the Bay of Biscay we ascertained in 1880. This *Galathodes* (*G. Marionis*), like its congeners, is blind; its eyes exist, but have no pigment.

Among the Mollusca some remarkable species dredged at 550 metres within sight of Marseilles deserve to be cited, such as *Pholadomya Loveni* of the coast of Portugual, *Limopsis aurita*, *Terebratella septata* of the Pliocene of Sicily, and a new species of *Nassa*. We give also a list of the species found at this depth *.

Between 500 and 2600 metres there are formed at certain points enormous accumulations of empty shells, Pteropods, and pelagic Heteropods, over a bed of very fine mud, in which live species of *Nucula*, *Syndesmya*, *Leda*, *Nassa*, *Siphonentalis*, and *Dentalium*; specimens of *Xylophaga dorsalis*, a species which often attacks the gutta percha of the telegraphic cables, are lodged in the fragments of drift-wood. On the shore of Morocco we collected *Modiola lutea*, a species discovered in 1880 in the Bay of Biscay. Lastly, the sand and mud of the Barbary coast are full of small *Marginellæ*, such as characterize the shelly bottoms of Spain and Portugal.

The investigation of the Bryozoa of the great depths has been hitherto almost entirely neglected; and hence Dr. Jullien has found in the collections made by us many remarkable species which establish a passage between the fauna of the Mediterranean and that of the Atlantic. Some of them were previously represented only by forms regarded as peculiar to the Cretaceous deposits.

The Cœlenterata include some interesting types; and their study has revealed facts which deserve mention. The Zoantharia Malacoderma only furnished a large *Ilyanthus* with long non-retractile tentacles. The Coralliaria are not numerous. *Caryophyllia clavus* was taken down to a depth of 300 metres. *Dendrophyllia cornigera* appeared off Ajaccio, forming banks at 540 metres; to its branches were attached

* PTEROPODA: *Hyalæa tridentata*, *H. vaginellina*, *Cleodora lanceolata*. HETEROPODA: *Carinaria mediterranea*. GASTEROPODA: *Trophon vaginatus*, *Chenopus Serresianus*, *Nassa limata*, *N. Edwardsii*, sp. n., *Emarginula fissura*, *Ringicula leptochila*. SCAPHOPODA: *Dentalium agile*, *Siphonentalis quinquangularis*. LAMELLIBRANCHIATA: *Limopsis aurita*, *L. minuta*, *Arca pectunculoides*, *Malletia cuneata*, *Nucula sulcata*, *Pecten influens*, *P. Hoskynsii*, *Astarte sulcata*, *Isocardia cor*, *Venus multilamella*, *Neæra cuspidata*, *N. abbreviata*, *Syndesmya longicallus*, *Pholadomya Loveni*. BRACHIOPODA: *Terebratella septata*, *Terebratula vitrea*, *Terebratulina caput-serpentis*.

some *Caryophylliæ* identical with those collected in the Atlantic by the 'Travailleur.' Several specimens of *Desmophyllum crista-galli*, resembling those of the Bay of Biscay, were collected by the 'Charente' upon the telegraph cable at 450 metres; they were associated with *Caryophyllia clavus* and with *Caryophyllia electrica*, A. Milne-Edwards, which Duncan has lately redescribed under the name of *C. Calveri*. The coralligenous station of Cape Sicié (50–80 metres) gives shelter to numerous Annelids; but nearly all of them have already been indicated off Marseilles; one of them, *Serpula crater*, has been met with upon the telegraph cable down to a depth of 1800 metres. We may also notice a small Gephyrean which has not previously been found in the Mediterranean, namely *Ocnesoma Steenstrupii*, the usual companion of the *Brisingæ* in the Atlantic.

On two different occasions the dredge brought up specimens of *Brisinga*, which were certainly not numerous, and were of small dimensions when compared with those of the Atlantic; but the presence in the Mediterranean of this magnificent starfish, which has hitherto been thought peculiar to the cold and deep regions of the ocean, is an entirely unexpected fact. Our *Brisinga* were obtained between 550 and 2660 metres. We may also cite *Archaster bifrons*, which was supposed to be peculiar to the Atlantic, and a new species of *Asterias* (*A. Richardi*, Perrier), taken at 540 metres, endowed with the faculty of reproducing by the division of its body into two parts.

During the whole of the expedition we collected samples of the bottom, which were treated with osmic acid and placed in well-closed tubes, to be afterwards submitted to the examination of M. Certes. It was indeed interesting to ascertain whether Infusoria resembling or of different form from those of the surface lived in the great depths. These organisms, however, were not met with; the soft Rhizopods, or those with chitinous carapace, which occur at the surface of the sea, are rare; finally, the examination of the finest granules never betrayed the existence of *Bacteria* or other Microbia. A sounding made between Nice and Corsica, at 2660 metres, furnished several small *Actinophryes*.

The study of the Foraminifera is far from being completed; but the results already obtained show the variety of the species, and the existence of numerous oceanic types and forms known in the fossil state. One Foraminifer especially is of much interest, because, when young, it displays the form of a *Cristellaria*, and subsequently that of a *Nodosaria*. M. Schlumberger has described it under the name of *Amphicoryna*.

The Sponges are not at all abundant at great depths.

Beyond 600 metres and down to 2660 metres they were represented only by *Tetillæ* and *Holtenia Carpenteri*. The latter species approaches much nearer the surface in the Mediterranean than in the Atlantic; we have ascertained its existence at 307 metres off Toulon; and in this zone it occurs with certain representatives of the littoral fauna, such as *Polymastia mamillaris* and *Tethya lyncurium*.

It results from our investigations that the Mediterranean must not be regarded as forming a distinct zoological province; we believe that this inland sea has been populated by the immigration of animals coming from the ocean. These, finding in this recently-opened basin * a medium favourable to their existence, established themselves in it definitively; and often their development and reproduction have taken place more actively than in their original locality. Near the shores especially the fauna exhibits a luxuriance which the other European coasts rarely present. One can easily understand that some of these animals, placed under novel biological conditions, have become slightly modified in size or in other external characters, which explains the slight differences existing between certain oceanic forms and the corresponding Mediterranean forms. If the primordial separation of the two faunas has been accepted, this is because the productions of the Mediterranean were compared with those of the North Sea, the English Channel, or the coasts of Brittany, whilst those of Portugal, Spain, Morocco, and Senegal ought to have been selected as terms of comparison. The animals of these regions must, in fact, have been the first to emigrate towards the Mediterranean; and in proportion as we know these faunas better, we see the differences which zoologists thought they could observe between them gradually disappear.

The explorations that we had made in the Mediterranean during the month of July necessitated some complementary researches in the Atlantic, especially on the coasts of Spain and Portugal; and the Minister of Marine authorized us to continue our dredgings on board the 'Travailleur' during the month of August.

In the abyssal parts of the Atlantic, the bottom, instead of being uniformly covered by a thick bed of ooze, was of a very varied nature, and formed sometimes of compact limestone, sometimes of pebbles resembling Pyrenean rocks in their

* See, as to the period of the formation of the Mediterranean, Blanchard, "La Géographie enseignée par la nature vivante" (Bull. Assoc. Sci. France, July 7, 1878, p. 200).

composition, sometimes of Nummulitic limestone, and sometimes of an ooze almost exclusively composed of Foraminifera*. Near the northern coast of Spain numerous and for the most part unknown Corals had been developed at certain points, and at depths of more than 1000 metres, with marvellous luxuriance, sheltering a whole population of Mollusca, Annelids, Crustacea, and Zoophytes. The dredgings that we made in these spots reached depths which had never been explored in European seas. On the 17th August, in the Bay of Biscay, in 44° 48′ 30″ N. lat. and 7° 0′ 30″ longitude west [of Paris], we dredged in a depth of 5100 metres, and met with numerous animals, of small size it is true, but some of them belonging to elevated groups, such as an Annelid, an Amphipod Crustacean, and three Ostracoda; the other species, which were very various, belong to the groups Foraminifera and Radiolaria. The temperature of the stratum of water that rested upon this bottom of 5100 metres was 3°·5 C. (=38°·3 F.).

I have already said that generally the Fishes escaped our researches; nevertheless off the coast of Portugal, in sight of Cape Espichel, at about 1200 metres, we took three very rare species of sharks, which never seem to quit the abysses of the ocean, namely *Centrophorus squamosa*, *C. crepidalbus*, and *Centroscymnus cœlolepis*, which were described a few years ago by MM. Barboza du Bocage and Brito-Capello. Another fish, *Mora mediterranea*, was also captured under the same circumstances.

The collections of Crustacea are very abundant. *Lispognathus Thomsoni*, Norm., *Scyramathia Carpenteri*, Norm., and *Geryon longipes* were found at depths varying between 896 and 1225 metres. *Bathynectes longispina*, discovered by Stimpson off Guadeloupe, was met with by us off Cape Ortegal at about 900 metres. A Pagurid of the great depths seems to me to be identical with an American species (*Eupagurus Jacobii*, A. M.-E.)†.

The group Galatheidæ is numerously represented. In 1880 I indicated the existence of a *Galathodes* in the Bay of Biscay at 1950 metres‡. Another species was captured this year on

* M. Schlumberger has found 116,000 Foraminifera in 1 cub. cent. of this mud.

† This species is identical with *Parapagurus pilosimanus*, Smith.

‡ *Galathodes acutus*, A. M.-E.—The rostrum is slender, pointed, and as long as the inner antennæ. The carapace has two lateral spines, one at its anterior angle, the other, which is very small, behind the cervical groove. The second, third, and fourth segments of the abdomen are armed in the median line with a spine directed forward.

the north coast of Spain at 900 metres; like the preceding, it is blind*.

An *Elasmonotus*†, also blind, found at 1068 metres off Oporto is very distinct from the four species of this genus which inhabit the American seas. A *Diptychus* also exists in European waters‡.

Pontophilus norvegicus, Sars, supposed to be peculiar to the northern seas, occurred, associated with the preceding species and with another unknown spinous *Pontophilus* §. A Macruran of the family Hippolytidæ must form a new genus‖. Its eyes have no corneas, and are terminated by three small spines. The genus *Acanthephyra*, of which I have described several species from the West-Indian seas, has a representative ¶ in the abysses of the ocean off the Berlingues at 2590 metres. Its colour, like that of the *Gnathophausiæ*, is a magnificent carmine red. A *Pasiphaë* which the dredge brought up from 900 metres presented exactly the same coloration. Among the most important acquisitions made in these same

* *Galathodes rosaceus*, A. M.-E.—The rostrum is broad and lamellar, and terminates anteriorly in three points, of which the median one is keeled above, and the lateral ones very short. The sides of the carapace are armed with four spines. The segments of the abdomen are rounded above. The arm and forearm of the chelæ bear a few spines; the hands are unarmed; the colour is rosy.

† *Elasmonotus Vaillantii*, A. M.-E.—This species is well characterized by the arrangement of the gastric region, which is much elevated, and bears in front two small symmetrical points dominating the rostrum. The latter is short, simple, and pointed. The abdomen is keeled transversely, and armed upon the first two segments with a median projection bearing two little spines.

‡ *Diptychus rubrovittatus*, A. M.-E.—This species differs from *D. nitidus* by its smaller eyes, its more widened and shorter carapace, its more triangular and less slender rostrum, and its stronger and more stumpy chelæ. Its colour is purplish rosy, marked on the chelæ with lighter bands. (Brought up from a depth of 900 metres.)

§ *Pontophilus Jacqueti*, A. M.-E.—The body is larger and more thickset than that of *P. norvegicus*; its rostrum is shorter and does not reach to the level of the corneæ. A single median spine exists upon the carapace above the anterior cardiac lobe; two other lateral spines appear in front of this. Lastly the branchial lobe also bears a spine.

‖ *Richardina spinicincta*, A. M.-E.—The rostrum scarcely passes beyond the basal joints of the outer antennæ; it bears twelve teeth above, and five below. The carapace bears, in front, on each side of the gastric region, three small spines, and a cincture of spicules behind the cervical groove. The feet of the first two pairs are didactyle; those of the last two pairs are multiarticulate and monodactyle.

¶ *Acanthephyra purpurea*, A. M.-E.—The rostrum is slender, nearly straight, and bears nine teeth on its upper and five on its lower margin. The third segment of the abdomen is armed with a median posterior point directed backward. Another similar, but smaller, point exists on the fifth and the sixth segment.

regions I may note a Pycnogonidan living at 1918 metres, and remarkable for its size*; with the legs extended it measured 0·25 metre. In its external characters it greatly approaches *Colossendeis leptorhynchus*, Hœck. It is the giant of the Pycnogonidæ of our seas.

The Mollusca were very numerously represented to the north of Spain; and several species were new. The subjoined list† will give a faint idea of this fauna; for the picking-out of the smaller species is not yet completed.

The Bryozoa form a notable proportion of the animals that we have found upon rocky and pebbly bottoms. Twenty-seven species belonging to known genera, and ten which must be placed in new genera, have already been recognized by Dr. Jullien. Interesting facts arise out of their investigation. *Setosella vulnerata* presents ovicells only in the great depths of 1000 metres; nearer the surface, whether in the Mediterranean or near the Shetlands, it seems to be unable to reproduce. Another species of the same genus, *S. Richardii*, is distinguished by the unicellulate arrangement of the zoarium. We may also indicate *Anarthropora monodon*, Busk, *Mucronella abyssicola*, Norm., *Schizoporella unicornis*, and *Mucronella Peachii*, Johnst., which had not been previously met with in these regions, and appeared only to exist either on the Shetland coasts or in the American seas.

The collection of Coralliaria is especially remarkable for the abundance and beauty of the specimens belonging to the genera *Lophohelia* and *Amphihelia*. *Lophohelia prolifera* was dredged at about 1000 metres. *Amphihelia oculata* was obtained from the same station, as well as *Amphihelia rostrata*, Pourtales, previously known only in the West-Indian sea.

* *Colossendeis Villegentii*, A. M.-E.—The rostrum is shorter than that of *C. leptorhynchus*; but the body is longer.

† Pteropoda: *Cuvieria*, *Spirialis*, *Hyalæa*, *Cleodora*, &c. Gasteropoda: *Murex Richardi*, sp. n., *Trophon vaginatus*, *Columbella acutecostata*, *Marginella clandestina*, *Hela tenella*, *Trochus gemmulatus*, *Trochus Vaillantii* (affinis *T. Ottoi*, Philippi, from the Tertiaries of Sicily), *Zizyphinus Folini*, sp. n., *Turbo filosus* (identical with those from the Sicilian Tertiaries), *Solarium discus*, *Pyramidella mediterranea*, *Actæon exilis*, *Scaphander punctostriatus*. Scaphopoda: *Siphonentalis quinquangularis*, *Dentalium agile*. Lamellibranchiata: *Spondylus Gussoni*, *Lima Marionis*, sp. n., *Amusium lucidum*, *Pecten vitreus*, *P. Hoskynsi*, *Limopsis aurita*, *L. minuta*, *Arca nodulosa*, *Nucula sulcata*, *Malletia obtusa*, *M. cuneata*, *Neæra rostrata*, *N. striata*, *Axinus ferrugineus*, *A. biplicatus*, *Lyonsia formosa*, *Syndesmya longicallus*, &c. Brachiopoda: *Terebratella septata*, *Terebratulina tuberata*, *T. caput-serpentis*, *Terebratula sphenoida*, *Terebratula* sp. (a very large species, of the size of *T. Wyrillei*, Davidson, from the Antarctic seas, and very nearly allied to *T. scillæ* from the Pliocene of Southern Italy), *Rhynchonella sicula*.

M. Marion indicates further a series of *Desmophyllum crista-galli*, and two new species of Caryophyllians—one that must be ranged among the true *Caryophylliæ*, while the other takes its place in the group of the *Bathycyathi*. The Hydroids, everywhere feebly represented, belong to northern forms (*Dicoryne flexuosa*, Sars, *Lophotænia tenuis*, Sars). A species of *Aglaophenia* (*A. Folinii*) is new.

Among the Vermes we may indicate some fine Sipunculians belonging to North-Atlantic types (*Ocnesoma Steenstrupi*, *Sipunculus norvegicus*). A *Phascolion* and an *Aspidosiphon* will have to be carefully compared with the species recently described by the naturalists of Christiania.

The Chætoped Annelids are not rare. One of the most remarkable is a large blind *Eunice* (*Eunice amphiheliæ*, Marion) found in a parchment-like tube, around which was developed a fine polypary of *Amphihelia oculata*. We may mention further a fine *Aricia* allied to *A. Kupferi*, Ehl., a *Euphrosyne*, a *Terebella*, an Amphoretian, a *Nereis*, species of *Polynoë*, and a *Vermilia*, the tube of which is attached to *Lophoheliæ*.

All the Alcyonaria possess great interest. There are:—1. *Funiculina quadrangularis*, Pall.; 2. *Pennatula aculeata*, Kor. & Dan.; 3. *Kophobelemnon stelliferum*, Müller; 4. *Umbellula ambigua*, Marion*, a very curious species, which closely approaches *U. grandiflora*, Köll., from Kerguelen's Land; 5. *Plexaura desiderata*, Marion, found at 1094 metres, and not yet described; 6. *Muricea paucituberculata*, Marion; 7. *Isis* (*Mopsea*) *elongata*, Esper; 8. Two very curious Gorgonidæ, the intermediate characters of which are very remarkable and which belong to new types.

The Echinodermata are very numerous; and among these animals the Stellerida possess a very marked predominance. The dredge brought up numerous fragments of *Brisinga*, and even a perfect example of this fine sea-star. M. Perrier has ascertained that the arms undergo metamorphoses with age; and their study proves that the genus *Hymenodiscus* is intimately related to the *Brisingæ*.

Among the new species of Asteriidæ we may indicate two *Pedicellasteres* (one with five, the other with six arms), and a very remarkable small sea-star which must form a genus under the name of *Hoplaster spinosus*, Perrier. The Ophiu-

* This species differs from *Umbellula Thomsoni* by having its sarcosoma destitute of calcareous sclerites. The polyps are grouped, without any bilateral arrangement, upon a large inflation; there is no rhachis. The axis at its upper extremity forms a very wide and twisted lamina, so as to throw out all the polyps in a pendent bunch.

ridæ are represented by the genera *Ophioglypha*, *Ophioderma*, *Ophiacantha*, *Ophiothrix*, *Amphiura*, and *Asteronyx*. A species remarkable for its short and raised arms was previously unknown; it was found at 390 metres, and has been designated *Astrophis pyramidalis*. We may also cite numerous examples of *Phormosoma*, which seem to belong to two species—one identical with *Phormosoma hystrix*, Wyv. Th., and another that we found last year in the Bay of Biscay.

Sponges were collected in great numbers; most of them, captured at more than 1000 metres, belong to the type Hexactinellidæ. We cannot here furnish a complete list of them. We may indicate several *Farreæ*, *Aphrocallistes Bocagei*, *Holtenia Carpenteri*, *Sympagella nux*, *Hyalonema lusitanicum*, *Pheronema Carpenteri*, and a magnificent specimen of *Asconema setubalense*. Two fine specimens of *Euplectella suberea* were taken off the Berlingues at 3307 metres; a little further north the dredge brought up a new species allied to the *Fieldingiæ*, which has been named by M. Vaillant *Parafieldingia socialis* *.

In samples of the bottom from the Mediterranean M. Certes was unable to find any Infusoria; a sounding taken in the ocean at 1145 metres furnished him with an organism which may belong to that group and with a fine *Euglypha* of elongated form, resembling both in form and structure the freshwater *Difflugiæ* described by Dr. Leidy.

In a report so brief as this I have only been able to indicate the most remarkable results acquired for science by the expedition of the 'Travailleur.' It is possible, however, now to form some idea of the numerous materials for study that we have collected; and it may be asserted, without fear of contradiction, that one could not now hope to gather so ample a harvest of new facts by exploring with ordinary means even the most distant regions of the globe. These submarine explorations promise still further revelations; and we must continue them. It will not do for France to leave to others the care of studying the depths of the seas which bathe her shores; it is a task that belongs to her, and she must make its accomplishment a point of honour.

* The spherical spicular aggregations, instead of being enclosed in a spiculosarcodic tissue, as in the *Fieldingiæ*, are contained in a loose felted mass composed of long acicular sclerites.

VI.—*Descriptions of new Longicorn Coleoptera* (Prionidæ *and* Lepturidæ) *from Madagascar.* By CHARLES O. WATERHOUSE.

Prionidæ.

Macrotoma gracilicornis, n. sp.

Elongata, parallela, angusta, brunnea, opaca; capite thoraceque rugosis, elytris dense granulatis, antennis gracilibus parce punctatis, tibiis haud spinosis. ♂.

Long. 14 lin.

This is an elongate, narrow, light-brown species. Antennæ slender, scarcely reaching to the apex of the elytra; the basal joint thick, strongly and closely punctured; the third joint very long, as long as the fourth, fifth, and nearly half the sixth joints together, nearly cylindrical, sparingly punctured above, more closely at the side; the fourth to eighth joints sparingly punctured; the apex of the ninth and all the tenth and eleventh joints opaque and longitudinally finely striate; the eleventh joint is as long as the tenth and two thirds of the ninth together, it gradually becomes wider to rather beyond the middle, and then narrows to the apex and is unusually acuminate. The head is coarsely rugose, the eyes widely separated. Thorax closely and coarsely rugose, one third broader than long, moderately convex (with a short slight impression in the middle of the base), slightly narrowed anteriorly, the sides very gently arcuate and with the rugosities appearing like irregular crenulations; the posterior angles furnished with an acute conical short tooth directed outwards and backwards. Elytra subparallel, thickly beset with minute slightly shining granules, more distinctly so at the base than at the apex; convex at the base, very slightly impressed between the shoulder and the scutellum; the apical angle with a small acute tooth. Anterior femora moderately asperate, but the asperities are not acute; the tibiæ sparingly punctured, the punctures closer along the margins. Intermediate legs smoother. Posterior femora sparingly punctured, with a few small acute asperities below; the tibiæ sparingly and finely punctured. Sterna fuscous. Abdomen ferruginous, with dusky margins to the segments, the apical segment scarcely emarginate.

Hab. Madagascar, Fianarantsoa.

The form of the apical joint of the antennæ and the scarcely emarginate apical segment of the abdomen will be found useful characters in distinguishing this species.

Macrotoma sodalis, Waterh.

This species was described from a single female example from Fianarantsoa (Ann. & Mag. Nat. Hist. 1880, v. p. 413). The British Museum has just received three examples (two males and one female) which I think must be referred to this species. The female differs from the type in being larger, 19½ lines long; the thorax is rather less narrowed anteriorly, the sides have some short acute teeth; and the spine at the posterior angle is curved and stronger than in the type.

The males differ from the female which accompanied them in having the legs more robust and the tarsi broader; the antennæ extend nearly to the apex of the elytra; the basal joint is more robust, coarsely punctured; the third joint is rather stout, a little narrowed to its apex, strongly and closely punctured, and beset with very short acute spines, especially below; the fourth, fifth, and sixth joints are sparingly punctured, the seventh more thickly punctured, the eighth to eleventh opaque and longitudinally channelled. The femora and tibiæ have the edges set with strong acute spines; but the anterior femora have few or no spines above; the anterior tibiæ are opaque and rough.

One of the males has the spine at the posterior angle of the thorax straight and very acute; the other specimen has this spine stronger and curved. Length 15 lines.

All the specimens have the thorax sparingly clothed with yellowish pile, and the elytra beset with stiff hairs.

Supposing all these specimens to be referable to *M. sodalis*, the question now arises, how do the males differ from *M. obscura*, Waterh. (*l. c.* p. 410)? *M. obscura* was described from a single male example from Antananarivo, 22 lines long, and of a blackish colour. The males just received are smaller, brown, and have the anterior tibiæ furnished with comparatively few spines arranged in a single line on each edge; in *M. obscura* the spines are close together, and are arranged in a double series on each edge.

M. obscura and *M. sodalis* may hereafter prove to belong to the same species; but at present it appears better to consider them distinct.

Lepturidæ.

Anthribola femorata, n. sp.

Testaceo-brunnea, plus minusve ochraceo-pubescens; capite thoraceque supra vittis duabus nigrescentibus, elytris (lateribus denudatis evidenter sat crebre punctatis) sat brevibus, postice bene

attenuatis, paulo divaricatis, gutta humerali, altera sub humero, macula sub scutello et altera post medium nigris, fascia communi ante medium ochraceo-pubescente; pedibus brunneis, femoribus incrassatis, subtus dente acuto armatis. ♂ ♀.

Long. 6 lin.

Hab. Fianarantsoa (*Rev. W. Deans Cowan*). Brit. Mus.

In the 'Annals & Magazine of Natural History,' vol. xv. (1875) p. 414, I described a species, which I called *Sagridola quinquemaculata*, from a female example. Mr. H. W. Bates, in the 'Entomologist's Monthly Magazine' (xiv. 1879, p. 251), described an allied species (for which he also proposed a new genus) under the name *Anthribola decoratus*, from an example which he queries as a female.

The species above described and the two species I have just alluded to are all very closely allied, and are very similarly coloured, although my *S. quinquemaculata* has the yellow spots much more clearly defined. Having now the sexes of two of the species, I am in a position to give characters by which all three may be distinguished, as follows:—

A. quinquemaculata.—Of this species I have only seen the female. It has no black subbasal band on the elytra nor spot below the shoulder; it has a quadrangular yellow spot at the apex of each, not extending up the suture. The sterna and legs are blackish brown, clothed with very short fine grey pubescence; the tibiæ are very slender; the femora are only moderately thick, and have no tooth below. The apical segment of the abdomen below is acuminate, very shining, sparingly and very delicately punctured.

The specimen which I mentioned as the male of this species in the 'Annals' for March 1880 (p. 215) belongs to the following species.

A. decorata.—This has a black subbasal band across the elytra, sometimes interrupted, but leaving a black spot below the shoulder; the yellow at the apex forms a stripe on the suture. Sterna and legs (except the inner part of the femora) densely clothed with longer and coarser rusty-yellow pubescence. The legs are much stouter than in *A. quinquemaculata*; the femora are more incrassate, with a small acute tooth below (in both sexes) near the apex. The male has the apical segment of the abdomen (seen from below) thickly and distinctly punctured, truncated at the apex, and distinctly concave. The female has this segment less acuminate than in *A. quinquemaculata*, and has the punctuation much more distinct.

A. femorata is a smaller insect, of a more uniform brownish colour, with brown legs, with more prominent eyes, shorter

and much more acuminate elytra, with the coloration of *A. decorata*, but less bright, with the subbasal black band narrower and interrupted. The femora are dentate and blackish below in both sexes, moderately thick in the female, very thick in the male, and projecting in a marked manner beyond the apex of the elytra. The pubescence on the sterna and legs is dirty yellow, very delicate and less thick on the tibiæ and tarsi; the tibiæ are very slender. The apical segment of the abdomen as in *A. decorata*.

I think that my *Sagridola flavicollis* would be better placed in the genus *Anthribola*, on account of its slender antennæ; but its thorax is more regularly convex and has no central channel.

Mastododera Jansoni, n. sp.

M. nodicolli affinis et similis, nigra; antennis, pedibus elytrisque rufis, his basi angustissime infuscatis, thoracis angulis posticis magis elevatis.

Long. 11–13 lin.

Very close to *M. nodicollis*, Klug, of which I at first mistook it for a variety. In colour it differs in having the legs entirely red, and there is scarcely any trace of black at the base of the elytra. The thorax has the discal swellings scarcely visibly raised, whilst the swellings above the posterior angles are much more elevated and more convex. This difference is very marked when the insect is viewed from behind.

Hab. Madagascar, Fianarantsoa.

VII.—*Descriptions of new* Buprestidæ. By Charles O. Waterhouse.

Nascio carissima, n. sp.

Elongata, angusta, viridis; capite supra, thoracis vitta mediana lata, cyaneo-nigris; elytris apice haud spinosis, gutta humerali plagisque duabus cyaneo-nigris, plagis gutta flava ornatis.

Long. $2\frac{1}{2}$ lin.

Head and thorax densely punctured. Thorax evenly convex, slightly constricted behind the middle. Elytra punctate-striate, the surface all finely coriaceous; the apex of each elytron slightly rounded, and finely serrate on the outer side. The suture is black; and there is a round spot on each shoulder.

Rather behind the middle of each elytron there is an elongate purple-black or bluish-black patch (the two patches united posteriorly by a narrow band across the suture), which emits from the lower outer angle a fine line which extends to the apex. There is a round yellow spot in each patch.

This species resembles *N. viridis*, M'Leay, but has the apex of the elytra simple &c.

Hab. North Australia. In Mr. Janson's collection.

Psiloptera thoracica, n. sp.

Elongate and parallel-sided, rather depressed, of a uniform brassy-bronze colour. Head coarsely punctured. Thorax one third broader than long, rather flat on the disk, sloping down at the anterior angles, rather rounded at the sides in front of the middle, gently sinuate before the posterior angles, which are acute and somewhat diverging; there is a shallow sparingly punctured longitudinal impression in the middle of the disk, the space on each side of it being almost without punctures; and outside this, anteriorly, there is a small irregular smooth patch; the sides posteriorly are very distinctly inflated and very strongly punctured; on the inner side of the inflation the surface is deeply impressed and rugulose. The elytra at the base are not broader than the thorax, parallel to rather behind the middle, where they are a very little broader, and then narrowed to the apex, which is narrowly truncated: each elytron has three very slightly raised lines (besides the suture); these lines are a little narrower than the rather strongly, not very thickly, punctured intervening spaces; they are smooth, but with about seven or eight ovate finely punctured impressions; at the side there is a somewhat broad submarginal, impressed, finely punctured stripe, with very fine whitish pile; the margin itself is incrassate below the shoulders. The prosternal process is bicanaliculate. The prosternum and flanks of the prothorax are very coarsely punctured.

Hab. S.E. Africa, Mamboio. Brit. Mus.

Curis corusca, n. sp.

Parallela, depressa, cuprea; thorace vittis duabus cyaneis, lateribus angulatis, elytris parallelis, ad apicem angustatis striato-punctatis, plaga obliqua nigrescente juxta suturam notatis, lateribus postice haud reflexo-marginatis.

Long. $5\frac{3}{4}$ lin.

Form of *C. caloptera*, Boisd., but with the thorax decidedly but obtusely angular at the sides. Head very thickly punc-

tured, not quite so strongly concave as in *C. caloptera*. Thorax tinted with golden green on the disk, with a short deep-blue elongate spot on each side of the middle line, which is neither impressed nor elevated; the punctuation is moderately close, but lightly impressed on the disk, closer and stronger at the sides, not so strong nor so close as in *caloptera*. There is a small fovea in the middle of the base, a stronger one at the side at the angulation, and a slight impression within the posterior angle. The elytra are relatively a trifle shorter than in *caloptera*, with the margins posteriorly not reflexed, scarcely or only very finely crenulated, the apices obtusely rounded. The punctuation, which is arranged in lines, is delicate on the disk, very strong and distinct at the sides, all the interstices appearing smooth.

Hab. Australia. Brit. Mus.

This species forms a passage from *C. caloptera* to *C. viridicyanea*, Fairm.

Conognatha interrupta, n. sp.

Parallela, nitida, læte cyaneo-violacea, subtus cyanea; scutello elongato, elytris ad apicem vix angustatis, sulcatis, ante apicem utrinque macula triangulari pallide flava marginem attingente.
Long. 10 lin.

This insect belongs to a group of species which are parallel in form, having the denticulation at the apex of the elytra commencing after the yellow band (*C. trizonata*, *eximia*, &c.); the usual band, however, is interrupted, so that there remains only a spot on each elytron at the side. The thorax is very convex, not much narrowed in front, with the posterior angles not nearly so much diverging as in *C. eximia*; the punctuation is not very close, and is very fine. The scutellum is long and parallel, rounded at the apex. The striæ of the elytra are continued to the base, but are not there much impressed, very deep towards the apex. The prosternum is somewhat unusually convex, or as if inflated.

Hab. Bogota. Brit. Mus.

Before describing this species I had to look at M. J. Thomson's "Typi Buprestidarum," in which several species of this genus are described, and have noted that *C. paradisea*, Th., appears to be *C. equestris*, Fabr.; *C. princeps*, Th., is *C. princeps*, Gory; *C. comitessa*, Th., appears to be *C. Batesii*, Saunders.

VIII.—*On new British Cladocera discovered by Mr. Conrad Beck in Grasmere Lake, Westmoreland.* By E. Ray Lankester, M.A., F.R.S., Jodrell Professor of Zoology in University College, London.

Two years ago I identified *Leptodora hyalina*, Lillj., and *Hyalodaphnia Kahlbergensis*, Schödl., as British Cladocera in specimens sent to me by Mr. Bolton, of Birmingham, who had obtained them from the Olton reservoir near that town.

But few of the remarkable forms of Cladocera which occur in the larger lakes of Continental Europe had previously been recognized as occurring in this country; and it was therefore interesting to establish the occurrence of the two species above named.

The list of British Cladocera has now been extended by the observations of Mr. Conrad Beck, who, during the past summer, examined the Entomostracous fauna of Grasmere Lake, and made careful drawings of the specimens obtained, which he was kind enough to submit to my examination at University College. Mr. Beck has been able to refer the forms observed by him to the following species, three of which are new to British waters; and I may add that I have compared his drawings with the published drawings of these species and can confirm the accuracy of his identifications.

1. *Leptodora hyalina*, Lilljeb. ♂. Taken Sept. 16th.
2. *Hyalodaphnia Kahlbergensis*, Schödl. Abundant, Sept. 9th to 16th.
3. *Holopedium gibberum*, Zaddach. Thirty specimens, each encased in a gelatinous globe, Sept. 7th to 16th.
4. *Latona setifera* ♂ and ♀, Straus (Weissman). Sept. 3rd to 14th.
5. *Bythotrephes*, sp. Sept. 14th. This appears to be a new species, distinct from the *Bythotrephes longimanus* of Leydig.

At the same time, together with these interesting species, hitherto unknown in Britain, Mr. Beck observed and made drawings of the following, already known to Baird as British species, some being of rare occurrence:—*Sida crystallina*, O. F. Müller (Straus genus); *Daphnia vetula*, Müller, and *D. reticulata*, Jurine; *Eurycercus lamellatus*, O. F. Müller (Baird genus); *Alona quadrangularis*, Müller (Baird genus); *Peracantha truncata*, Müller (Baird genus).

It appears probable that in lakes where species of the Salmonid *Coregonus* are found, there also will be found the large deep-water Cladocera, such as *Holopedium* and *Bythotrephes*, which serve these fish as food.

IX.—*On some Points in the Morphology of the Rhabdophora, or true Graptolites**. By JOHN HOPKINSON, F.L.S., F.G.S.

PROFESSOR M'COY, in his 'British Palæozoic Fossils,' published in 1854, in describing a graptolite from the Skiddaw Slates and other beds, to which he gave the name of *Graptolites latus*, speaks (p. 4) of "transverse diaphragms" being present near the base or proximal termination of the calycles (hydrothecæ), and shows the position of these diaphragms in a figure (pl. 1 B. fig. 7) which probably represents part of a branch of *Didymograptus patulus* or an allied species; but it is impossible to refer with certainty to any one species his aggregate *Graptolites latus*, now universally admitted to have been founded upon fragments of branching forms.

No further allusion appears to have been made to the presence of any diaphragms or septa until, in 1868, I stated (Journ. Quekett Microsc. Club, vol. i. p. 161) that I could find "no indication of a dividing septum" in graptolites "if we except a few forms in which there is an impressed line between the hydrothecæ and the periderm" (perisarc), which I then compared to that "at the base of the hydrothecæ in the Sertulariadæ." I accepted, however, the generally-received view that the graptolites agree with the Hydrozoa in their hydranths not having been cut off from the common cœnosarc by an actual entire or perforated septum, differing thus in their structure from the majority of the Polyzoa.

More recently Professor Allman, in his 'Monograph of the Calyptoblastic or Tubularian Hydroids' (Ray Society, 1872), not admitting the presence of any septum or constriction, has compared the calycles of the Rhabdophora to the fixed nematophores (sarcothecæ) of the Plumularidæ. He observes (p. 179) that "the denticles of the graptolite have their cavity uninterruptedly continuous with that of the main tube, there being no diaphragm or constriction of any kind at the point where the one passes into the other;" and, alluding to Prof. M'Coy's observations already mentioned, he says that he "speaks of a septum at the base of the denticles in certain graptolites, but subsequent observations have not tended to confirm this statement."

I have recently had the opportunity of examining an extensive collection of graptolites made by Mr. W. Kinsey Dover, F.G.S., from the Skiddaw Slates, mostly from Skid-

* Read before the British Association (Section C), York, Sept. 7th, 1881. An abstract appeared in the 'Geological Magazine' for October.

daw and the adjacent hills, amongst which are a few specimens from Falcon Crag distinctly showing internal structure. The species of which the structure is most clearly defined are *Didymograptus extensus*, Hall, *D. patulus*, Hall, and *Tetragraptus serra*, Brong. (= *T. bryonoides*, Hall). In several specimens of these species the hydrothecæ are seen to be separated from the perisarc by a distinctly-marked septum; and the perisarc is, moreover, in specimens of all the three species, seen to be jointed, or crossed by transverse septa.

In a portion of a branch of *Tetragraptus serra* (fig. 1) this structure is particularly clearly seen. The specimen is preserved in section with its interior partly filled in with mineral matter differing altogether from the slaty matrix in which it is enclosed; and iron-pyrites has taken the place of its once chitinous external membrane.

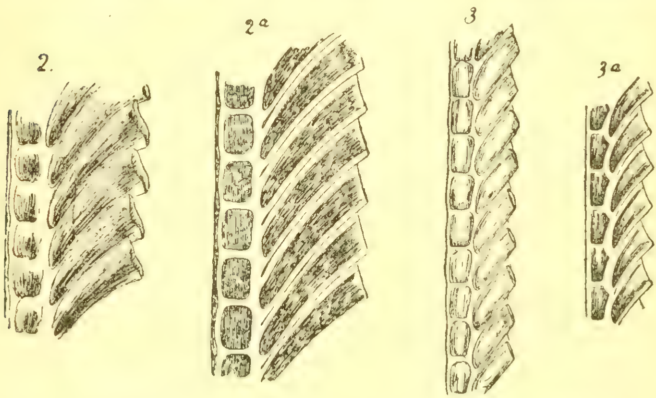
Fig. 1.—Part of a branch of *Tetragraptus serra*, natural size.

On the dorsal margin is the virgula with a wavy outline. Next to this is the perisarc or common canal which formed the channel of communication between the individual hydranths, looking where filled in like a jointed tube, and where the infiltrated mineral matter has been removed, or has never been deposited, appearing as a series of rectangular depressions divided from each other by transverse walls or, rather, distinct ridges; for they do not nearly fill up the space between the two sides of the perisarc. The hydrothecæ, where their interior is filled in with mineral matter, are each articulated with the corresponding rectangular cavity of the perisarc, a ridge or partial septum dividing them from it; and where their interior is not filled in they are divided from the perisarc and from each other by a perceptible ridge. They are curved, springing from the perisarc at an angle of from 30° to 40°, which gradually increases to 50°; and they are wider at their distal than at their proximal end, the margin of which is of a curved form, slightly flattened where in contact with the corresponding division of the perisarc. In one portion their external apertures are seen. Here and there the pyrites has filled up spaces which have probably been caused by the contraction of the infiltrated mineral matter, giving a few of the thecæ a jointed appearance; but this is evidently an accidental occurrence, and the *regular* jointing of

the sections of the perisarc and line of junction of the thecæ with it could not be thus explained.

In the other specimens examined very similar appearances are presented. In both *Didymograptus extensus* and *D. patulus* there is a jointed perisarc with thecæ distinctly separated from it. They appear, in fact, to have budded from it as the leaves of an exogenous tree bud from the stem or twig which supports them, and not to have been continuous with it as are the leaves of endogenous trees with their support. In this point it would seem that we have an analogy with the vegetable kingdom. It is well known that in some graptolites we frequently have the perisarc preserved without the calycles which should spring from it; and so may we have a tree without its leaves, though in both cases there has been organic connexion between the now disconnected members. In the graptolite, as in the tree, there is no actual septum; there is a ridge, a constriction, occasionally forming a very sharp line of demarcation, but in most cases scarcely, if at all, perceptible.

This "impressed line" I first noticed in 1868 in graptolites from the Lower Silurian rocks of the south of Scotland. In 1872 I found several specimens of the species *Monograptus bohemicus*, Barr., *M. Nilssoni*, Barr., and *M. leintwardinensis*,



Figs. 2, 2 *a*. Different portions of the branch of *Tetragraptus serra* represented in fig. 1, magn. 5 diameters.

Figs. 3, 3 *a*. Different portions of a branch of *Didymograptus extensus*, magn. 5 diameters.

Hopk., in the Ludlow rocks near Ludlow, more clearly indicating such a structure; but it is not until now that I have been able actually to see not only the external indication of a

dividing ridge, but the ridge itself, projecting into the internal cavity of the graptolite, and so clearly in some instances that when examined under the microscope its thickness can be measured and the extent of its projection estimated. The accompanying figures (figs. 2, 3) are reduced from drawings thus made with the microscope and camera lucida.

It would thus appear that in certain graptolites the calycles seem to be completely cut off from their supporting perisarc, this appearance being due to a constriction or the presence of a partially-dividing ridge, and also that in these same forms there are at least *constrictions* in the perisarc dividing it into sections, from each of which a calycle is produced. This is the structure which generally obtains in the recent Thecaphora; and I therefore think that it can now no longer be maintained that the calycles of the graptolite are not true hydrothecæ,—the conclusion arrived at from previous investigations into the morphology of the Rhabdophora, and especially of the reproductive organs of certain graptolites *, that they are the Palæozoic representatives of the recent Hydrophora, thus being confirmed by specimens from rocks which would naturally be supposed to be most unlikely to yield fossils showing minute internal structure.

That these appearances have not been more frequently seen is probably owing to the imperfect state of preservation in which the Rhabdophora usually occur, and the very rare occurrence of specimens in section with the interior removed.

Mr. Dover's collection of graptolites is probably the most complete which has hitherto been made from the Skiddaw Slates; and a careful examination of it might add considerably to the hitherto-known fauna of these beds. Some graptolites are shown by specimens in his possession to have attained a very large size, there being many single branches of *Didymograpti* and *Tetragrapti* about a foot in length, a few of which show no signs of termination at either end. Every division of the series has been diligently worked for fossils by him; but it is only from one bed, exposed at Falcon Crag, that specimens preserved in an uncompressed state and showing internal structure have been obtained.

* See Ann. & Mag. Nat. Hist. (ser. 4) vol. vii. p. 317.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 2, 1881.—R. Etheridge, Esq., F.R.S., President, in the Chair.

The following communication was read :—

"On the Genus *Stoliczkaria*, Dunc., and its Distinctness from *Parkeria*, Carp. and Brady." By Prof. P. Martin Duncan, M.B. Lond., F.R.S., F.G.S., Pres. R.M.S.

The author discussed in detail the characters of his Syringosphæridæ, a group of Rhizopoda established by him for the reception of the spheroidal organisms known in India as Karakoram stones.

The order Syringosphæridæ consists of spherical or spheroidal bodies composed of numbers of conical radiating congeries of minute, continuous, long, bifurcating and inosculating tubes, and of an interradial tube-reticulation arising from and surrounding the radial congeries. The tubes open at the surface in eminences and in pores. The walls of the tubes consist of granular and subspiculate carbonate of lime. There is no cœnenchyma. In *Syringosphæria* (fully characterized by the author in 'Scientific Results of the Yarkand Mission,' Calcutta, 1879 p. 10), the body is covered with large compound wart-like prominences with intermediate verrucosities, or with modifications of such structures; and between these eminences are shallow depressions bounded by tubes. The surface has tubes opening upon it from the internal radial series and also from the interradial reticulation; there are also masses of tubes running over it and converging on the eminences. In *Stoliczkaria*, a second genus, the surface is covered by numerous granulations, separated by intervals about equal to their breadth. There are no pores on the surface; but tube-openings occur in the granulations. The central ones, which are small, are the terminations of the very numerous radial series, which, in section, are not very conical but nearly straight; and give off minute offshoots to the surrounding convoluted and varicose larger tubes of the interradial series, which open towards the periphery of the granulations. There is no cœnenchyma. The species is named *Stoliczkaria granulata*.

The author compared the structure of the Syringosphæridæ with that of *Parkeria*, to which they have a considerable resemblance in external appearance. The internal structure differs. *Parkeria* shows a radial series of large tubes, a system of interspaces in concentric series, and a labyrinthic structure of irregularly-shaped chamberlets, communicating with each other and cancellous in appearance. The interspaces are traversed by one or more large radial tubes; and the floor of each interspace towards the centre is made up of the minute chamberlet structure, the openings of which communicate only with the interspace beyond. The labyrinthic structure sometimes stretches across the interspaces,

and the radial tubes communicate at their sides with the labyrinthic chamberlets of the lamellæ forming the floor and roof of the interspaces. The continuity from the centre of the body to the circumference is thus defective, and the body consists of radial tubes and of a labyrinchic structure of a cellular and semicellular character.

The author maintained that the two structures were intrinsically different; and he also indicated a difference in the mineral condition of the fossils, *Parkeria* being always phosphatic, whereas no phosphate of lime could be detected in *Stoliczkaria*.

November 16, 1881.—R. Etheridge, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "Additional Evidence on the Land Plants from the Pen-y-glog Slate-quarry, near Corwen." By Henry Hicks, Esq., M.D., F.G.S.

The author stated that since the date of his former paper (Quart. Journ. Geol. Soc., August 1881) he had ascertained that plant-remains occurred in the slaty beds down to the base of the quarry, though much obscured by cleavage. The larger specimens are in the form of anthracite. Mr. Carruthers states that there is sufficient evidence to show that they are the remains of vascular plants with some resemblance to the Lycopodiaceæ. Some of the fragments are from 4 to 5 inches wide, and the author had traced trunks some feet in length. He thought they had drifted to the position where they were now found. Leaf-markings generally are not preserved; but, from the wrinklings still remaining on some specimens, he thought it probable they had been covered with leaves spirally arranged. Some fragments show scars arranged irregularly on the surface; probably these are fragments of roots. The plant seems to some extent to combine the characters of *Stigmaria*, *Sigillaria*, and *Lepidodendron*. Further details of the appearance of the specimens were given. For one which appears to differ from all hitherto described he proposes the name of *Berwynia Carruthersii*.

2. "Notes on *Prototaxites* and *Pachytheca* from the Denbighshire Grits of Corwen, North Wales." By Principal Dawson, LL.D., F.R.S., F.G.S.

The author stated that he had obtained specimens of the Plant-remains from near Corwen, and that among them there were two kinds, one dark, the other light-coloured. In the former the long cells and woody fibres are filled with rods of transparent siliceous matter, and the walls represented by a thick layer of carbon. The lighter kind consists of the siliceous rods alone, which are thus in the same state as the asbestos-like silicified Coniferous wood of the Californian gold-gravels. In both the siliceous rods show traces of the irregularly spiral ligneous lining of the cell-walls. From these and other characters the author refers the specimens to his genus *Prototaxites*,

which, he says, is not an Alga, but a woody terrestrial plant. The author did not state that *Prototaxites* actually belonged to the Taxineæ, but that its fossilized wood showed a resemblance to that of some fossil Taxineæ. The remains discovered by Dr. Hicks differ, as already recognized by Mr. Etheridge, from *Prototaxites Logani*, Daws.; and the species may be named *P. Hicksii.*

Of *Pachytheca* the author stated that he had specimens from the Upper Silurian of New Brunswick, and these and the Welsh specimens seem to belong to the genus *Ætheotesta*, Brongn., and to be nearly allied to *Æ. devonica*, Daws., from the Devonian of Scotland. These fossils occur associated with *Prototaxites*, not only at Corwen, but in the Upper Ludlow of England, in the Upper Silurian of Cape Bon Ami, and in the Lower Devonian of Bordeaux quarry opposite Campbellton in New Brunswick; and as the author maintains *Ætheotesta* to be a seed, and Brongniart compared it with the seeds of the Taxineæ, this may be taken as additional evidence in favour of the Taxine or, at any rate, Gymnospermatous nature of *Prototaxites.*

December 7, 1881.—R. Etheridge, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "On some new or little-known Jurassic Crinoids." By P. Herbert Carpenter, Esq., M.A. Communicated by Prof. P. Martin Duncan, M.B. Lond., F.R.S., F.G.S.

The author first described in detail a species from the Great Oolite, principally of Lansdown, and hence known as the "Lansdown Encrinite." It was described in 1828 by Dr. J. E. Gray as *Encrinites* (*Apiocrinites*) *Prattii*, and subsequently by Goldfuss as *Apiocrinites obconicus*, and by D'Orbigny as *Millericrinus obconicus*, whilst Bronn, in 1848, recorded it as *Millericrinus Pratti*. The stem varies greatly in length and in the number of its joints; and from the characters presented by the fossils the author came to the conclusion that the species was either pedunculate or free; and he cited various examples of nearly allied pedunculate and free Crinoids. The general aspect of the calyx, the component plates of which were described in detail, is exceedingly pentacrinoid, whether it is viewed from the side or from above; and the arm-joints are short and nearly oblong in outline, having pinnules alternately upon opposite sides. The nearest allies of *Millericrinus Prattii* are *M. Nodotianus*, d'Orb., and the var. *Buchianus* of *M. Munsterianus*; and of *Pentacrini* the one which most resembles it in the characters of the calyx is the North-Atlantic *P. Wyville-Thomsoni.*

The remainder of the paper was devoted to the description of two Jurassic Comatulæ, namely *Antedon calloviensis*, from the Kelloway Rock, described before the Society on June 22, 1881, and a new species, *Antedon latiradia*, from the Great Oolite of Bradford.

2. "Notes on the Polyzoa of the Wenlock Shales, Wenlock Limestone, and Shales over the Wenlock Limestone. From material supplied by G. Maw, Esq., F.L.S., F.G.S." By G. R. Vine, Esq. Communicated by Dr. H. C. Sorby, F.R.S., V.P.G.S.

The author has received from Mr. Maw about 1½ hundredweight of materials washed out of the Wenlock deposits of Shropshire, representing the contents of from 6 to 8 tons of unwashed material. From this material he extracted the specimens of Plants, Actinozoa, Echinodermata, Crustacea, and Polyzoa; and he gave a tabular synopsis of the species and their distribution, with the addition of types from the Wenlock Limestone and of the species of Brachiopoda referred to in a paper by Messrs. Maw and Davidson in the 'Geological Magazine' for 1881.

With regard to the Polyzoa, the author remarked that below the Cretaceous series the two great divisions of Chilostomata and Cyclostomata do not hold good, and suggested that the classification of Palæozoic Polyzoa should be based on the arrangement and character of the cells, in combination with habit. The forms characterized in the present paper were *Stomatopora dissimilis*, Vine, and vars. *elongata* and *compressa*, *Ascodictyon stellatum*, Nich. & Eth., *A. radiciforme*, sp. n., *A. filiforme*, sp. n.?, *Spiropora regularis*, sp. n., *S. intermedia*, Vine, *Diastopora consimilis*, Lonsd., *Ceriopora*, Goldf., *Hornera crassa*, Lonsd., *H.? delicatula*, sp. n., *Polypora? problematica*, sp. n., *Fenestella prisca*, Lonsd., *Glauconome disticha*, Goldf., *Ptilodictya lanceolata*, Lonsd., *P. Lonsdalei*, sp. n., (= *P. lanceolata* auctt.), *P. scalpellum*, Lonsd., *P. interporosa*, Vine, and *P. minuta*, Vine.

MISCELLANEOUS.

On the Postembryonic Development of the Diptera. By M. H. Viallanes.

Among insects, it is in the Muscidæ that we observe the greatest differences between the larva and the perfect animal; and it is also in them that the metamorphoses that take place during the pupal period are the most profound, which explains why exact investigations upon the metamorphoses of insects have been directed principally to these insects or to nearly allied animals. Having repeated the work of my predecessors *, I have been able to discover some new facts, of which I now have the honour to place a summary report before the Academy.

When the larva becomes motionless and transformed into a pupa, not only does the skin of the segments answering to the head and

* My investigations were made in M. Milne-Edwards's laboratory; they relate to *Musca vomitoria*.

thorax of the adult disappear, but the skin of the whole body is destroyed, in consequence of a degeneration of the hypodermic cells, to such an extent that at a certain moment the animal is only limited by a thin cuticle, beneath which is a thick layer of embryonic cells, originating, as described by me in a previous communication*, from the muscular nuclei which have proliferated, and before the invasion of which the contractile substance of the muscular fibres has disappeared.

The embryonic cells which almost completely fill the body of a pupa are not derived from the muscular nuclei alone; they are also formed by the proliferation of the cells of the adipose body. This function of the cells of the adipose body was not previously known. When a larva is on the point of becoming a pupa, numerous daughter cells appear in the midst of their protoplasm; subsequently the envelope and the nucleus of the cells of the adipose body disappear; the daughter cells are set free, multiply in their turn, and display all the characters of embryonic cells.

The return of the tissues to the embryonic state is the cause of this very remarkable fact, that at a certain moment the pupa has really the characters of an embryo. When we examine a section made across the abdomen of a pupa of from two to four days standing, we observe that the body is composed of only two layers of central cells, one forming a solid cord, composed of the epithelial cells of the digestive tube which have reverted to the embryonic state, the other peripheral, consisting of the embryonic cells originating from the muscular nuclei and the cells of the adipose body.

When the tissues of the larva are destroyed, the tissues of the adult form. We know from the investigations of M. Weissmann, that the integuments of the head and thorax are developed at the expense of a certain number of buds preexistent in the larva, and designated *histoblasts* (*Imaginalscheiben*). From not having had recourse to the method of sections, my predecessors have been mistaken as to the structure of these little bodies; they are not, as has been supposed, small saccules filled with cells. The histoblast, when not much developed, appears in a section to consist of a hollow sphere, one half of which had been immersed in the other; we may therefore consider it to be formed of two laminæ, an internal and an external one. The inner lamina is thick and composed of pyriform cells placed side by side; the outer lamina is thin and consists of a single layer of flattened cells. During the development of the histoblast the outer lamina disappears, and the inner lamina increases to form the integuments of the adult. The histoblasts of the eyes present the same structure as the others; the following are the only peculiarities observed in them. The inner lamina is composed of large cells, very regularly arranged side by side, of a cylindrical form, terminated at its outer extremity by a flattened base, drawn out into a point at the other extremity. Each of them is continuous by its produced extremity with one of the fibrils of

* See 'Annals,' ser. 5, vol. vii. p. 352.

the optic nerve. Among the large cells small ones are observed. As M. Weissmann has shown, each of the large cells will become one of the simple eyes, the totality of which constitutes the retina. The small cells become the choroid cells.

My predecessors, who had not observed the destruction of the integuments of the later segments of the larva, thought that the integuments of the abdomen of the adult were formed by a simple transformation of the hypodermic cells of the latter. Having already shown that the whole of the skin of the larva disappears, I had to ascertain how the integuments of the abdomen of the adult are developed. I have ascertained that they are formed at the expense of the embryonic cells which fill the body of the pupa, and the origin of which has been indicated above. These embryonic cells become converted into hypodermic cells. This change does not take place at all points of the abdomen at the same time; but, in each segment, the hypodermis of the adult appears at first at four points, two below and two above.

As the organs of the larva disappear, and the organs of the adult are formed, the nervous centres undergo very important internal modifications. Their investigation, which has not even been touched upon, is environed with technical difficulties. I have succeeded in overcoming nearly all of these. I have traced step by step the internal modifications that the nervous centres undergo during pupal life; and I shall shortly have the honour to make known to the Academy the principal results of my researches upon this subject.—*Comptes Rendus*, Nov. 14, 1881, p. 800.

Development of the Ovum of Melicerta. By M. L. Joliet.

The development of the embryo of the Rotatoria has hitherto been studied only in two genera, namely in *Brachionus* by Salensky, and in *Pedalion* by Barrois. The mode of segmentation is still unknown.

Although we have ascertained that the development of the winter egg and of the male egg agrees generally with that of the female summer egg, it is more particularly upon this last that our investigations have been made.

Within the sac of maturation it presents, in the midst of the germinal vesicle, a small but very distinct germinal spot. After deposition this spot soon disappears. It did not appear to me that there was any emission of a polar globule. The first segmentation-plane, perpendicular to the larger axis of the egg, which is an irregular ovoid, divides it into two very unequal segments. Afterwards these two segments divide symmetrically, and so that each of them furnishes eight of the spheres which constitute the egg in the stage XVI. We observe only that the spheres derived from the larger primary segment are larger than the others, and larger in proportion to their distance from the animal pole. It seems as if each of them had a certain degree of animality. During the whole

period of the segmentation the behaviour of the nuclei and asters is very remarkable. We also observe a movement of rotation (already recognized by Barrois in *Pedalion*), which tends to transport the spheres derived from the small segment from the animal pole to the opposite pole, skirting the dorsal surface, while the large spheres give place to them and glide along the ventral surface.

At the stage XVI. the egg consists of a row of four small cells derived from the small segment and occupying the dorsal surface, of a row of four spheres gradually increasing in size occupying the ventral surface, and of two rows of four cells placed on the sides, four of them derived from the large and four from the small segment.

It is only after this stage XVI. that the dorsal and lateral cells begin to multiply much more rapidly than the ventral ones and to spread over their sides. In proportion as these small cells glide over the surface of the large ones the latter sink by an oscillatory movement, which at first removes the smaller ones, until finally the last and largest of them slips in its turn beneath the former ones, leaving an orifice (the blastopore), which remains visible for some time, almost exactly at the spot where the mouth will afterwards be formed.

Even by the situation it occupies from the moment of the closure of the blastopore, it is easy to see that the last sphere enveloped corresponds to the intestine, which it will serve to form, if not entirely, at least in great part.

In the same way, by the manner of their inclusion, the two following large spheres will be upon the ventral surface of the former, in the situation that will be occupied by the genital glands. Subsequently, when the spheres come to divide and subdivide, this arrangement will become very obscure; but for a certain time after the closure of the blastopore it remains perceptible, and shows that the embryo is formed, if not of continuous lamellæ, at least of masses of tissue which obviously correspond to the endoderm, mesoderm, and ectoderm of the higher animals, both by their position and their destiny.

When the subdivision has been carried to its last limit, the egg appears as a finely moruloid mass, in which we can recognize only an outer light layer and a dark central one. The cephalic region always remains lighter. We can no longer distinguish the blastopore.

Soon afterwards an oblique furrow, which constricts the mass and separates the tail, appears on the side and along the ventral surface; the tail is thus folded under the ventral surface and directed towards the head, as in the embryo of *Brachionus* and *Pedalion*.

About the level of the extremity of the tail a depression appears in the cephalic mass. I do not know whether this corresponds to the depression described by Salensky in *Brachionus*; but it indicates the appearance, not of the mouth, but of the vibratile pit situated below the lip in the adult. A little later, and a little higher up, the mouth makes its appearance as a depression which no doubt sinks

far enough to form the mouth, but certainly not sufficiently to form the mentum. Still later, and also upon the back, the cloaca will be formed by an invagination of the ectoderm; and this, although very long in the adult, is still very short in the larva, and remains reduced to a simple emargination in the *Flosculariæ*. The cephalic region is soon bounded by a slight fold, which indicates the margin of the chitinous covering. The eyes make their appearance as two red points; cilia begin to move, at first upon the infrabuccal pit, then upon the mouth, and finally upon the top of the head, where they form a sort of circlet. The armature of the mastax is formed, the tail withdraws by degrees towards the extremity of the egg, the envelope of which it finally ruptures. It has already been described by several authors; and I shall dwell only upon this fact, that, like the larva of *Lacinularia* figured by Huxley, it presents cilia upon three points of the body—a continuous and scarcely sinuous circlet placed above the mouth, a second circle surrounding this circlet and the mouth, and extending even over the vibratile pit, and, lastly, a tuft of cilia at the extremity of the tail. The larva remains active for several hours, and then attaches itself by means of the glands contained in its tail. It is then that it begins to collect in the vibratile pit the minute particles suspended in the water. These it mixes with the secretion from a gland, hitherto taken for a ganglion, and, according to the judicious observations of Gosse and Williamson, forms of them those little balls which, when juxtaposed, constitute the tube that it inhabits.—*Comptes Rendus*, November 21, 1881, p. 856.

On a Yellow Variety of the Common Eel (Anguilla vulgaris, *Fl.*). By Dr. Heinrich Bolau, of Hamburg.

On the 2nd July, 1879, a very interesting, pure sulphur-yellow variety of our river-eel, which had been taken in the Elbe near Hamburg, was brought to me for the aquarium of our Zoological Garden here. This first example was followed by thirteen other similar ones in the interval between the 4th September and the 9th October of the same year. In the summer of the present year (1880) the occurrence of the yellow eels in the Elbe was repeated. On the 5th May I received two specimens, and then gradually, up to the 13th August, seven others.

Only the eel first captured, which is still living in the aquarium, is pure yellow without black spots. It is about 32 centim. (13 inches) long. Its upper surface and sides are of a beautiful light lemon-yellow; the muzzle is rather more orange-coloured. In the hinder half of the body, and especially the tail, there are on the sides numerous whitish spots in the yellow. The whole underside is whitish and shining, while the yellow parts of the body are dull. The fins are pale yellow and so translucent that the finer blood-vessels may be detected in them with the naked eye; in the same way the blood shows reddish through the skin on the whitish lower

jaw; and at the base of the tail, below the vertebral column, the pulsating movement of the blood passing from behind forwards in the subcaudal veins can be distinctly recognized.

The eyes of our animal are smaller than in the normal state, and therefore appear rudimentary. They are reddish violet; their background is without pigment, so that it appears red; on the other hand, dark pigment exists in an equatorial zone (taking the normal axis of the eye as axial); of course, however, these conditions cannot be ascertained with perfect certainty in the living animal.

As the yellow colour of this eel has remained unaltered to the present time (20th September, 1880) we have in it an example of the very rare case of leucæthiopism in a fish. Although the other yellow eels were at the first glance very like the one just described, they have proved very different from it in their whole behaviour. All had black spots upon a lighter or darker ground, and these spots were distributed either only upon the upper part of the head, or also over parts of the back. The eyes were always normal. In size the animals did not essentially differ from the first-mentioned eel.

The thirteen animals of this kind received by our aquarium in the course of the year 1879 all changed their colour by the winter; they gradually became darker and darker, until at last they had acquired the coloration of normal eels. This is the more remarkable as there were among them animals which, with the exception of the blackened head, were perfectly pure yellow, exactly like the above-described albino. The nine eels received by our aquarium this summer (1880) were likewise spotted with black upon a yellow ground. As yet they have not changed colour.

Similar yellow black-spotted eels have been observed several times besides the present cases. In the literature of the subject I find only one case. Brandt (Bull. de l'Acad. de St. Pétersb. vol. x. 1852, p. 13) and von Siebold (Süsswasserfische von Mitteleuropa, p. 19, note) mention an eel presented by Dem. Taglioni to the Paris Museum, which was pale brownish yellow (nankeen-yellow) and normally coloured only at the extremities of the nose and tail. The colour of the eyes is not stated in the description given by Meunier (in D'Orbigny's Dictionnaire d'Hist. Nat. tome i. 1841, p. 249). Brandt calls this the only example of a leucotic fish.

According to an oral communication, Prof. Möbius, of Kiel, received a similar female eel, fully $\frac{1}{2}$ metre long, on the 29th May, 1868; the animal had normal eyes.

According to a report in the public papers another eel of the kind was recently taken in a piece of water to the south-east of Bremen. In answer to a letter of inquiry addressed to the [former] possessors, MM. F. Klevenhusen & Co., of Bremen, those gentlemen have given me the following information about this fish:—The eel was exactly the colour of a goldfish and had black eyes; it had four or five black spots in the neighbourhood of the head; the belly also was darker than the back, so that in water it appeared as if the eel was lying on its back. The animal has been presented to the Bremen Museum; in spirit it has lost its red colour and become yellow.

Further, as regards the occurrence of leucotic fishes, Brandt, in the memoir above cited, describes a sterlet (*Acipenser ruthenus*), one foot in length, which was kept in the basin of the fountain of the Winter Garden at St. Petersburg, and had been brought there from Nischnij-Novgorod. With the exception of an inner silvery border, the iris was destitute of black pigment, so that the eye in front appeared for the most part veined with red, in consequence of the vessels shining through. With the exception of the very light pale grey fins, the ground-colour of the fish was pale brownish orange, with a flesh-coloured tinge on the sides and belly, while the somewhat darker dorsal surface had a yellow tinge.

Siebold (*l. c.* p. 18) mentions a loach (*Cobitis barbatula*) of a pale reddish colour and with a red pupil, which he found in the fish-market at Munich; and in the same place he cites Baldner, who describes a white burbot (*Lota vulgaris*) and a pale loach (*Cobitis barbatula*). These are the few examples of leucæthiopism that are known to me.

Consequently the occurrence of an albino eel (such as that above mentioned), as well as such an abundant appearance of yellow eels with black spots, have been previously unknown.—*Archiv für Naturgeschichte*, Jahrg. 47 (1881), p. 136.

On the Origin of the Central Nervous System of the Annelida. By Prof. Kleinenberg.

The author gives a summary of the results obtained by him in studying the development of the Polychæta, upon which he proposes hereafter to publish a more extended memoir with figures. At present he confines himself to making known the development of a single species, the larva of *Lopadorhynchus*, until its transformation into the perfect animal.

The most interesting point in the present communication is the discovery of the circular nerve of the vibratile organ of the larva, and the investigation of the development of the central nervous system of the perfect animal. The author has found that during the transformation of the larva into the perfect animal the circular nerve disappears completely, together with the vibratile organ; and the rudiments of the typical central organs are not derived from the transformation of the circular nerve, but originate from other parts of the ectoderm. Consequently the nervous system of an Annelid is not homologous with that of its larva. Kleinenberg thinks that the larvæ of the Annelida possess only the central anterior nervous system of the Cœlenterata, but that the perfect animals have central organs proper to them; so that "the organ of the inferior type originates and functions in the larva, but is eliminated and replaced by new formations in the adult animal."—*Atti della R. Accad. dei Lincei, Transunti*, vol. vi. p. 15, 1881.

How Orb-weaving Spiders make the Framework or Foundations of Webs. By the Rev. Dr. H. C. McCook.

Rev. Dr. H. C. McCook said that he had given attention during the past summer to the mode of constructing webs prevailing among orb-weaving spiders. He had been led to make some special studies of the extent to which air-currents are utilized in laying the foundation-lines upon which the orbs are hung by a remark of Rev. O. Pickard Cambridge in his work on the Spiders of Dorset*. "Spider-lines," he says, "may frequently be observed strained across open spaces of many feet and even yards in extent. This has been explained by some naturalists to have been done by the help of a current of air carrying the thread across. I cannot, of course, say that it has never been thus effected, though I have certainly never myself witnessed it. I have, however, on several occasions seen a spider fix its line, then run down to the ground, across the intervening space, and so up the opposite side, trailing its line as it went; and then having hauled in the slack, it fixed the line to the desired spot. This I believe to be the usual mode of proceeding in such cases."

Dr. McCook was satisfied that on both the above points this distinguished araneologist had failed to possess himself of all the facts; but he took up the points in question anew during the summer, and made notes of his studies. His previous opinion was fully confirmed. He had in a great number of cases observed orb-weavers passing from point to point by means of lines emitted from their spinnerets and entangled upon adjacent foliage or other objects. These mimic "wire-bridges" were of various lengths, owing to the direction of the wind and the relative positions of the spider and the standing objects around it. Lines of two, three, and four feet were frequent; lines of from seven to ten occurred pretty often; he had measured one twenty-six feet long, and in several cases had seen them strung entirely across country roads of from thirty to forty feet. Many of these lines he had seen carried by the wind directly from the spiders' spinnerets, had observed the entanglement, had seen the animal draw the threads taut and then cross upon them. That all the lines were similarly formed and used he had no doubt.

It was more difficult to determine the other question, viz. whether the lines used for the foundations of orb-webs were formed in the same way. Undoubtedly such lines are often made precisely as asserted by Mr. Cambridge. Dr. McCook had many times observed this; he had seen an orb-weaver after traversing a considerable space by a series of successive bridge-lines settle upon a site between the forked twigs of a bush, and carry her foundation-lines around in the manner described. But, on the other hand, he was prepared to say that the air-laid bridge-lines were also used for the foundations or frames of orbs.

1. First, he had observed that the hours in the evening at which

* Vol. i., Introduction, p. xxi.

the greatest activity in web-weaving began were those in which also began the formation of the bridge-lines. The latter action quite invariably preceded the former.

2. Again, a study of the foundation-lines of many webs gave more or less conclusive evidence that they were laid by the aid of air-currents. For example, the webs of some species, as *Acrosoma mitrata*, *A. spinea*, and *A. rugosa*, were frequently found strung between young trees separated by two or three yards. That these builders might have dropped to the ground, crept over wood, grass, and dry leaves, carrying the thread in the free outstretched claw, is, perhaps, not impossible, but did not seem at all probable to the speaker, although short spaces over smooth surfaces might well be cleared in this way. One web he found spun upon lines stretched from the balustrade of a bridge that spans a deep glen in Fairmount Park to the foliage of a tree that springs out of the glen at least twenty-five feet below. Unless foundations were formed by line-bridging the interspace of a yard or more, it must be inferred that the spider had dropped from the balustrade to the glen, crossed the interval to the trunk of the tree, ascended it, and, having made the detour of nearly sixty feet to the point directly opposite that from which she started, drawn her long line taut, and so completed her foundation. Dr. McCook thought that such a supposition could not be entertained, and it was clear that a breeze carried the line across from the spider's spinnerets.

Even stronger examples of circumstantial evidence were noted. Very many webs of *Tetragnatha extensa* and *T. grallator* were seen spread upon bushes overhanging pools and streams of water; others were seen stretched between separated water-plants, or from such plants to the shore. Either the foundation-lines were borne by air-currents, or the spiders must have crossed upon the water, carrying their lines. The latter supposition is not wholly untenable, the speaker thought, but would hardly be raised by any one who had studied the spinning-habits of the creature.

One other example may be cited. At Cape May, by the Landing, where pleasure-boats used for sailing upon the inlet are stored, there is an immense colony of Epeiroids, chiefly *Epeira strix*, *E. vulgaris*, and *E. domiciliorum* (Hentz). Great numbers of these spiders had their lines strung between the opposite, exterior walls of the boat-houses, which are built upon piles driven into the water. These lines were about 9 feet long, stretched over the water at heights varying from 1 to 10 feet. Most of them passed from wall to wall; many were fastened at one end upon piles and sticks driven here and there between the houses. Even if one were to admit that *Tetragnatha* could carry a free line over the smooth surface of an inland pool, it is past belief that the above-named Epeiras performed the same act upon the rough waters of an inlet of the Atlantic Ocean. The only reasonable conclusion is, that bridge-lines were formed by air-currents.

3. It was greatly desired that to the above cases of circumstantial

proof might be added actual observations of the use for foundations of those lines stretched by air-currents. Three summer evenings were devoted to obtaining this result, without complete success. On one evening the observer was interrupted and called off at the very critical period of his observation; on the other two evenings the wind was unfavourable. But some valuable results were obtained, and the webs of three adult individuals of *Epeira strix*, one male and two females, were selected, the den or nest of each spider located, and the web entirely destroyed, including the foundation-lines. The latter precaution was made necessary by the fact that orb-weavers had been noticed to use the same foundation-lines, for many days, for the erection of their new webs. Young spiders had been seen on several occasions to utilize the radii and foundations of abandoned webs of adults as the frame-lines of their small orbs. The great value which may attach to these old foundations appeared strikingly in subsequent studies, and also the difficulty if not impossibility of procuring suitable foundations for the webs of large spiders without the aid of the wind.

Two of the webs (one of the females') were so situated that the prevailing air-currents so carried the lines that they could not possibly find an entanglement. In consequence, neither of these spiders succeeded, during two entire evenings, up to half-past ten o'clock, in making a web. They frequently attempted it in vain. One, which was more closely watched, was in motion during the whole period, passing up and down, from limb to limb, apparently desirous of fixing her orb in the former site, but completely confused and foiled. The site was one, moreover, which would have allowed her to carry around a thread with comparative ease, being a dead sapling that forked near the ground. The spider domiciled during the day on the ground, but had her orb at the top of the forks, a height of 6 feet. Thus the space to traverse in passing from the top of one of the forks to a similar point on the opposite one presented comparatively few difficulties. But no attempt was made to carry the line around; and as the wind had evidently not changed during the night, no web appeared upon the tree in the morning. During the next evening the same restless movement along the bare limbs of the sapling was repeated, and was terminated at a late hour by a rare accident. A large moth, attracted by the lantern, became entangled upon a single short thread strung between two small twigs, whereupon *E. strix* pounced upon it, swathed and fell to feeding on it. Next morning a tiny orb-web had been built around the shell of the moth at the point of capture.

During both evenings this spider at frequent intervals poised herself at the extremity of twigs, and emitted threads from her spinnerets which entangled upon some of the short twigs, but never upon the opposite fork, as the wind was steadily contrary. No other entanglement was secured, as there was no object in the direction of the wind for a great distance. However, Dr. McCook could at any time obtain an entanglement upon his hand by arresting the

thread. By imitating the motion of a swaying leaf or limb, the spider was caused to perceive the attachment and immediately ventured upon the line. Once the thread fastened upon the observer's face, and the animal was allowed to cross the line (4 or 5 feet) until within a few inches of the face, when she took in the situation, instantly cut the line and swung downward and backward over the long arc, and, after a few oscillations, climbed up the line to the point of departure. Her willingness to use the air-currents for making transit-lines was thus quite as manifest as her inability. The third spider exhibited a like behaviour.

4. The third individual, a male, did not attempt to spin an orb in the former site; the wind was unfavourable, but there would not have been much difficulty in carrying a cord around. He came out of his rolled-leaf den at 7.20 P.M., and for more than an hour laboured to secure a web foundation. He was located upon a dead end of a bough of a tree with many branching twigs. As with the former individual, so with this: many efforts were made to obtain foundations by sending out threads from the spinnerets; and to this end he tried most of the numerous points of the twigs covering the territory which he seemed to have chosen as his general range. One of these, a little pendant which hung in the centre of the group, was taken as the basis of a most interesting operation. The spider dropped from the pendant by a line 3 or 4 inches long, grasped the line by one of the second pair of feet, and rapidly formed a triangular basket of threads by connecting the point of seizure with lines reaching to the feet of the remaining second and the third and fourth pairs. In this basket he hung head upwards, the body held at an angle of about 45°, the two fore feet meanwhile stretched out and groping in the air, as though feeling for the presence of obstructions, of enemies, or of floating threads. At the same time he elevated his spinnerets and emitted a line, which was drawn out at great length by the air and secured no entanglement. The body of the spider had a gentle lateral oscillation, which appeared to the observer to result from a voluntary twisting of the central rope by the animal, but may have been caused by the air; the effect, in either case, was to give the line a wider swing and much increase the chances of entanglement.

However, there was no entanglement, and the spider dropped several inches further down, and repeated exactly the process as described above. This was repeated again and again; and when the observer allowed the line to attach to his person the spider at once proceeded to satisfy himself of the fact, and then to venture a crossing. In all these actions there was evidence of a habitual mode of securing transit by bridge-lines.

During the intervals of these attempts, and indeed preceding them, the spider passed back and forth along all the branching twigs, leaving behind him trailed threads or lines connecting the ends, many of which seemed to be purely tentative. At last a central point was taken, a short thread dropped therefrom and attached to

one of these tentative lines. The confused network of circumjacent lines was gathered together in a little flossy ball at the point of union, which was now made the centre of the orb, the first drop-line and the two divisions of the cross-line constituting the three original radii. From there the spider proceeded to lay in the radii and complete the orb. The speaker described this process in full, as illustrated by the industry of this and other individuals. The time occupied in constructing the orb proper was half an hour, while the work of prospecting for and obtaining a foundation consumed more than an hour. Even then the orb was very irregular, and showed decided traces of the want of the usual well and orderly laid foundations. An examination of a number of web-sites which had been marked upon the same grounds showed that, in every case where the surroundings had allowed an easy and good entanglement by the wind, the spider had made webs at an early hour, and with straight and regular foundations.

Dr. McCook concluded that the above observations, although not wholly conclusive in themselves, were sufficient warrant for the belief that air-currents have a large part in placing the original framework or foundation-lines of orb-webs, and that spiders habitually make use of them for that purpose. He doubted, however, whether there was any thing like a deliberate purpose to connect the point of occupancy with any special opposite point. It seemed to him that the spider acted in the matter very much at haphazard, but with a general instinct of the fact that such behaviour would somewhere secure available attachments. Many of her bridge-lines were evidently tentative and were chiefly at the mercy of the breeze, although some observations seemed to indicate a limited control of the thread by manipulation.

He added that on previous occasions he had actually observed the laying in, by air-currents, of lines which were immediately used for foundations. The above studies had been undertaken simply to verify such studies, and because he had retained but the briefest notes of former observations. While this use of air-currents is certainly placed beyond doubt, it is as certainly not the only mode of laying foundation-lines, and is dependent very much upon the site chosen, the condition of the wind, the abundance of prey, &c. Webs built in large open spaces are perhaps always laid out by bridge-lines; in more contracted sites the frame-lines are generally carried around, and often a foundation is the result of both methods*.—*Proc. Acad. Nat. Sci. Philad.*, Oct. 4, 1881.

* Since these notes were communicated, a copy of 'Nature' (Sept. 22, 1881) has been received, in which it is said that Mr. Cambridge, in the second volume of his 'Spiders of Dorset,' modifies the opinion above quoted concerning the influence of air-currents. I have not yet received that volume, but make this statement on the authority of the journal referred to.—H. C. McC.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 50. FEBRUARY 1882.

X.—*On some new Species of Corals.* By Bryce Wright, F.Z.S. &c.

[Plates II., III., & IV.]

Of all the Hydroid Zoophytes few are more remarkable for their structure or conspicuous for their beauty of form or richness and variety of colour than the hydrocoralline Stylasteridæ.

Of one genus of this group, *Distichopora*, a considerable number of species are now recognized; but, owing to the fragile texture of the hydrophyton and the great depths they inhabit, *i. e.* 80 to 300 fathoms*, only fragments of some species have been hitherto obtained. After having had many examples under examination, principally those of *Distichopora coccinea* and *D. violacea*, I find that these splayed corals rarely attain to any size, 3 or 4 inches being the average height of full-grown specimens. I was therefore much pleased, when examining the extensive and beautiful series of natural-history and other objects collected by Lady Brassey during the well-known voyage of the yacht 'Sunbeam' in 1876, to find amongst others two perfect examples, each of an undescribed species, new to science, which throw considerable light upon

* Count de Pourtales, Mem. Mus. Comp. Zool. Harvard Coll. Cambridge, U. S. A., vol. ii.

the form and structure of these corals, and show that the Distichoporidæ fall into two natural divisions, each characterized by the foliations of their branches—those in *D. Brasseyi*, *D. Allnutti*, and *D. irregularis* being more or less solid and rounded, and those in *D. violacea*, *D. coccinea*, &c. being compressed and broad, shelving off at the edges, and more displayed ("gladiiform").

The only fossil species known (*D. antiqua*, Defrance) is found in the Tertiary deposits of France—the habitats of the living species being the Gulf-stream and in and about the West-India Islands and Florida, for *D. nitida*, Verrill, and *D. cervina*, *D. foliacea*, *D. sulcata*, *D. barbadiensis*, and *D. contorta*, of Pourtales. Most of these species are of a whitish tint, with the exception of *D. foliacea*, which is a pale pink-orange, whereas those inhabiting the Pacific are much more vivid in their colours:—*D. violacea*, Pallas, from Fiji and its vicinity, violet; *D. coccinea*, Gray, from the Marshall group, deep crimson; and *D. rosea*, Kent, East Australia, of a pale rose-colour. *D. irregularis*, Moseley, from Zamboanga, in the Philippines, is of a light pink, and the two species herein described are of a fuscous or deep foxy-red orange and of a pinkish orange respectively. Lady Brassey's specimens come from the Gilbert Isles, near the equator, and were presented to her by his Hawaiian majesty King Kalakaua. Two fragments, apparently undescribed, in the British-Museum collection may probably come from some of the Pacific islands and belong to the same division as those now described.

The bathymetrical position from which Lady Brassey's specimens were procured has unfortunately not been recorded, but they must have been, I think, obtained by diving, not by dredging; and as Sir Wyville Thomson, in the deep-sea dredging expedition in the 'Challenger,' obtained a solitary fragment at a depth of 10 fathoms, it seems feasible to suppose that the depths they inhabit in the southern seas are not so great as in those of the Mexican Gulf, more especially as the colours are so much brighter. The area over which the Distichoporidæ extend is from N. lat. 20° to S. lat. 30°, W. long. 150° to 180°.

Transverse and vertical sections of the branches (see Pl. IV.) show that the gastropores and dactylopores vary considerably in their relative gradation of sizes and in their arrangement, both forms of zooids being regularly and irregularly distributed even in the same species (see figs. 6 and 6*, Pl. IV.). These pores are enclosed by a compact network varying in the size and disposition of the meshes according to the respective species; in their immediate vicinity the walls of the

tubuli or canals are thicker than towards the extremities, and the enclosed cœnosarc is much denser, and opaque. The broken stems from which the sections were cut, exhibit immediately around the pores a dense white opaque body; and thence to the outside of the branch the peculiar colour of the coral obtains. These colours disappear in the microscopical sections.

HYDROIDEA.

Section Hydrocoralline, Moseley.

Fam. **Stylasteridæ**, Lamarck.

Genus Distichopora, Lamarck.

Distichopora Brasseyi, nov. sp.
(Pl. II. fig. 1, Pl. IV. figs. 3, 4, 4*, 4**.)

Cœnosteum a deep red, tinted or slightly mottled with orange at the extremities of the stems and adult branches, paling off into white and pale orange-yellow, basal portion of coral moderately solid; branches long and erect, slightly tortuous, not so curved or foliaceous as in most of the other species, rounded but slightly compressed in the plane of the flabellum; termination of main branches bilobed and occasionally trilobed; lateral branchlets not frondose; but chiefly elongate and obtusely pointed or clavate, moderately distant from each other; main stems closely set together. Surface of cœnosteum very minutely and tortuously canaliculated, as in the vertical section. The pore-rows in this and the transverse section exhibit the gastropores rather irregularly spaced and outlined, with the dactylopores slightly intermixed. Pore-rows situated very inequilaterally on each side of the flabellum. Stellate prominences or ampullæ (verrues stelliformes, *Lamarck*) abundant on the front and sides of branches, largely developed, hollow, and finely pustulated and prominent. These ampullæ are of late growth, when the organism was fully developed, since, while frequently occurring in proximity to the poriferous lines, they are never or very rarely intersected by them. Fig. 4**, Pl. IV., illustrates this very well, showing two separate ampullæ with the poral line running between. The back of the coral is free from this arrangement. The figures in Plate IV. represent a frond of this species reduced to $\frac{1}{6}$, to illustrate the form of branches as compared with those of *D. Allnutti* and *D. coccinea*, both figured natural size.

Height of specimen 16 inches, width 26 inches.

Hab. Gilbert Islands.

This unique coral is the largest and most perfect example known. Unfortunately, during the voyage of the 'Sunbeam' a few of the fronds at the left side were broken off; otherwise its width would have been 3 or 4 inches more.

Distichopora Allnutti, nov. sp.
(Pl. III. figs. 1 & 2, and Pl. IV. figs. 5, 6, 6*.)

Cœnosteum fuscous orange-red in colour, paling towards the extremities, infundibuliform, the branches ramifying from a massive solid stem; base very compact; branches stout, bulbiform, nearly circular, moderately ramose, with the extremities flattened, obtusely furcate; the younger and lateral branchlets more acutely pointed; main branches closely packed, giving a very stout appearance to the entire coral. Surface of cœnosteum more coarsely canaliculated and granulate than in *D. Brasseyi*, corresponding to the vertical and transverse sections (Pl. IV. figs. 6, 6*); poriferous zones on flabellar edges; gastropores closely placed to each other, with minute dactylopores on either side. Ampullæ small, flat, separated, forming a broad stellate mass, more conspicuous on the younger branches than on the older ones, placed towards the edge of the flabellum. Walls of canals thicker than in *D. Brasseyi* or *D. coccinea*. Canalicular meshes rather large. One of the fronds is figured life-size, with transverse section. Longest axis 9 inches, shortest 8 inches. Height in all $4\frac{1}{2}$ inches.

Hab. Gilbert Islands?

Figured $\frac{1}{3}$ natural size.

One portion, that coloured white, has been overrun with some hydroid Actinian polyp.

Distichopora coccinea, Gray.
(Pl. IV. figs. 7, 8.)

I figure a frond and section of *D. coccinea*, to show its structure in comparison with the two preceding species, as they appear to indicate different groups of this genus. In the one the branches are rounded; in the other (*D. coccinea* and *D. violacea*) they are compressed, somewhat broad, with shelving edges. In the former the gemmation takes place more laterally than in this species, where the main centres of the stem have a series of small compressed tubercles. Dr. Gray suggests that these may be the commencement of new branches, which a specimen in the British Museum seems to confirm.

Many examples of *D. coccinea* appear to be complete corals,

from showing a white portion on the stem below the ordinary deep-crimson cœnosteum. This is sometimes illusory, and does not always represent the true base of the coral, but is simply dead matter, caused by the solidification of the cœnosarc, the frond (perfect in itself) being only a portion of the entire coral.

ANTHOZOA.

Amongst the numerous varieties of Anthozoan zoophytes of the Eupsammidean types contained in the Brassey collection is one which I am unable to refer to any recognized genus, its affinities lying between *Balanophyllia* and *Dendrophyllia*. Like the former genus, it is free, simple, and erect; but the septa do not coalesce in either of the three examples, nor are they so many in number, or the columella so massive and well developed; and in the latter genus the corals are imbedded on either side of the branches ramifying from the main stem. The cœnenchyma overrunning the knoll upon which the corals are based is probably less an integral part of the animals themselves than a secretion laid down to render compact the decomposed trap-rock upon which they stand, so as to give them a firmer hold. There being no genus known to which it can be assigned, I have erected it into a new one, which I have much pleasure in dedicating to its discoverer, Lady Brassey.

Fam. **Madreporaria Aporosa.**

Subfam. *Eupsammidæ*, Lamarck.

Genus Brasseyia, Bryce Wright.

Brasseyia radians, nov. sp. (Pl. IV. figs. 1, 2.)

Corallum isolated, simple, erect, placed on the summit of a massive irregular-shaped block, the cœnenchyma being confluent between the corallites and over the entire mass, which has grown upon a decomposed trap-rock. The whole of this basal portion is incrusted with numerous marine organisms, Polyzoa, *Serpulæ*, *Spirorbis*, &c. Corallum simple, irregular in form, rugose, swollen at the base, and contracting towards the calice, ovoid; longest axis of largest coral at base $1\frac{1}{2}$ inch, at calice 1 inch; height 2 inches. Costæ broad, finely punctured or granulated, without cross bars. Epitheca dense, walls thick. Periphery ovoid and indented, irregular in outline. Fossula deep; columella spongious, occupying about

half the cup. Septa plain, margins simple, surfaces level with top of opening; primaries sloping forwards and downwards to the columella, arranged in five cycles of 2–3 systems; interseptal loculi open, free from trabeculæ. Colour cloudy white below the live portion of the coral, which is a chestnut-brown.

Extreme height $4\frac{1}{2}$ inches; length of largest corallite 2 inches; circumference of stem 5 inches.

Hab. Southern Seas. The precise locality is not known.

Balanophyllia Kalakauai. (Pl. III. figs. 3 & 4.)

This species is represented by two examples, the largest one situated on the base of the coral just described, the other fixed to the side of one of the specimens.

Corallum simple, tall, subcylindrical; base large, spreading, adherent, slightly tuberculated, wrinkled. Costæ granulated, without cross bars; pellicular epitheca thin. Calice ovoid, walls thick; columella prominent, spongious, porous, well developed. Septa in 5–6 cycles, coalescent (as in figure), margins sinuated, surfaces granulated.

Height of largest example $1\frac{1}{2}$ inch.

Hab. South Seas. Precise locality unknown.

EXPLANATION OF THE PLATES.

Plate II.

Distichopora Brasseyi, Bryce Wright, $\frac{1}{3}$ nat. size.

Plate III.

Fig. 1. *Distichopora Allnutti*, Bryce Wright, front view, $\frac{1}{3}$ nat. size.
Fig. 2. *Distichopora Allnutti*, Bryce Wright, side view, $\frac{1}{3}$ nat. size.
Fig. 3. *Balanophyllia Kalakauai*, Bryce Wright, nat. size.
Fig. 4. Opening of calice of *B. Kalakauai.*

Plate IV.

Fig. 1. *Brasseyia radians*, Bryce Wright, $\frac{1}{2}$ nat. size.
Fig. 2. Calice of *Brasseyia radians*, nat. size.
Fig. 3. Frond of *Distichopora Brasseyi*, $\frac{1}{6}$ nat. size.
Fig. 4. Transverse section of *Distichopora Brasseyi.*
Fig. 4*. Vertical section of *Distichopora Brasseyi.*
Fig. 4**. Section across two ampullæ and poriferous zones.
Fig. 5. Frond of *Distichopora Allnutti*, nat. size.
Fig. 6. Transverse section of *Distichopora Allnutti.*
Fig. 6*. Vertical section of *Distichopora Allnutti.*
Fig. 7. Frond of *Distichopora coccinea*, nat. size.
Fig. 8. Transverse section of *Distichopora coccinea.*
Fig. 8*. Vertical section of *Distichopora coccinea.*

XI.—*Classification of the Dinosauria.* By Prof. O. C. Marsh*.

In the May number of the 'American Journal of Science' (p. 423), I presented an outline of a classification of the Jurassic Dinosaurian reptiles of this country which I had personally examined. The series then investigated is deposited in the museum of Yale College, and consists of several hundred individuals, many of them well preserved, and representing numerous genera and species. To ascertain how far the classification proposed would apply to the material gathered from wider fields, I have since examined various Dinosaurian remains from other formations of this country, and likewise, during the past summer, have visited most of the museums of Europe that contain important specimens of this group. Although the investigation is not yet complete, I have thought the result already attained of sufficient interest to present to the Academy at this time.

In previous classifications, which were based upon very limited material compared with what is now available, the Dinosaurs were very generally regarded as an order. Various characters were assigned to the group by Von Meyer, who applied to it the term Pachypoda; by Owen, who subsequently gave the name Dinosauria, now in general use; and also by Huxley, who more recently proposed the name Ornithoscelida, and who first appreciated the great importance of the group, and the close relation it bears to birds. The researches of Leidy and Cope in this country, and of Hulke, Seeley, and others in Europe, have likewise added much to our knowledge of the subject.

An examination of any considerable portion of the Dinosaurian remains now known will make it evident to any one familiar with reptiles, recent or extinct, that this group should be regarded, not as an order, but as a subclass; and this rank is given to it in the present communication. The great number of subordinate divisions in the group, and the remarkable diversity among those already discovered, indicate that many new forms will yet be found. Even among those now known there is a much greater difference in size and in osseous structure than in any other subclass of vertebrates, with the single exception of the placental Mammals. Compared with the Marsupials, living and extinct, the Dinosauria show an equal diversity of structure, and variations in size from by

* Communicated by the Author, having been read before the National Academy of Sciences, at the Philadelphia meeting, November 14, 1881.

far the largest land animals known (50 or 60 feet long) down to some of the smallest, a few inches only in length.

According to present evidence, the Dinosaurs were confined entirely to the Mesozoic age. They were abundant in the Triassic, culminated in the Jurassic, and continued in diminished numbers to the end of the Cretaceous period, when they became extinct. The great variety of forms that flourished in the Triassic render it more than probable that some members of the group existed in the Permian period; and their remains may at any time be brought to light.

The Triassic Dinosaurs, although so very numerous, are known today mainly from footprints and fragmentary osseous remains. Not more than half a dozen skeletons at all complete have been secured from deposits of this period; hence many of the remains described cannot at present be referred to their appropriate divisions in the group.

From the Jurassic period, however, during which Dinosaurian reptiles reached their zenith in size and numbers, representatives of no less than four well-marked orders are now so well known that different families and genera can be very accurately determined, and almost the entire osseous structure of typical examples, at least, be made out with certainty. The main difficulty at present with the Jurassic Dinosaurs is in ascertaining the affinities of the diminutive forms which appear to approach birds so closely. These forms were not rare; but their remains hitherto found are mostly fragmentary, and can with difficulty be distinguished from those of birds, which occur in the same beds. Future discoveries will, without doubt, throw much light upon this point.

Comparatively little is yet known of Cretaceous Dinosaurs, although many have been described from incomplete specimens. All of these appear to have been of large size, but much inferior in this respect to the gigantic forms of the previous period. The remains best preserved show that, before extinction, some members of the group became quite highly specialized.

Regarding the Dinosaurs as a subclass of the REPTILIA, the forms best known at present may be classified as follows:—

Subclass DINOSAURIA.

Premaxillary bones separate; upper and lower temporal arches; rami of lower jaw united in front by cartilage only; no teeth on palate. Neural arches of vertebræ united to centra by suture; cervical vertebræ numerous; sacral vertebræ co-

ossified. Cervical ribs united to vertebræ by suture or ankylosis; thoracic ribs double-headed. Pelvic bones separated from each other and from sacrum; ilium prolonged in front of acetabulum; acetabulum formed in part by pubis; ischia meet distally on median line. Fore and hind limbs present, the latter ambulatory and larger than those in front; head of femur at right angles to condyles; tibia with procnemial crest; fibula complete. First row of tarsals composed of astragalus and calcaneum only, which together form the upper portion of ankle-joint.

(1.) Order Sauropoda (Lizard-foot). Herbivorous.

Feet plantigrade, ungulate; five digits in manus and pes; second row of carpals and tarsals unossified. Pubes projecting in front, and united distally by cartilage; no postpubis. Precaudal vertebræ hollow. Fore and hind limbs nearly equal; limb-bones solid. Sternal bones parial. Premaxillaries with teeth.

(1.) Family *Atlantosauridæ*. Anterior vertebræ opisthocœlian. Ischia directed downward, with extremities meeting on median line.

Genera: *Atlantosaurus*, *Apatosaurus*, *Brontosaurus*, *Diplodocus*, ? *Camarasaurus* (*Amphicœlias*), ? *Dystrophæus*.

(2.) Family *Morosauridæ*. Anterior vertebræ opisthocœlian. Ischia directed backward, with sides meeting on median line.

Genus *Morosaurus*.

European forms of this order: *Bothriospondylus*, *Ceteosaurus*, *Chondrosteosaurus*, *Eucamerotus*, *Ornithopsis*, *Pelorosaurus*.

(2.) Order Stegosauria (Plated lizard). Herbivorous.

Feet plantigrade, ungulate; five digits in manus and pes; second row of carpals unossified. Pubes projecting free in front; postpubis present. Fore limbs very small; locomotion mainly on hind limbs. Vertebræ and limb-bones solid. Osseous dermal armour.

(1.) Family *Stegosauridæ*. Vertebræ biconcave. Neural canal in sacrum expanded into large chamber; ischia directed backward, with sides meeting on median line. Astragalus coossified with tibia; metapodials very short.

Genera: *Stegosaurus* (*Hypsirhophus*), *Diracodon*, and in Europe *Omosaurus*, Owen.

(2.) Family *Scelidosauridæ*. Astragalus not coossified with tibia; metatarsals elongated; four functional digits in pes. Known forms all European.

Genera: *Scelidosaurus, Acanthopholis, Cratæomus, Hylæosaurus, Polacanthus.*

(3.) Order Ornithopoda (Bird-foot). Herbivorous.

Feet digitigrade, five functional digits in manus, and three in pes. Pubes projecting free in front; postpubis present. Vertebræ solid. Fore limbs small; limb-bones hollow. Premaxillaries edentulous in front.

(1.) Family *Camptonotidæ.* Clavicles wanting; postpubis complete.

Genera: *Camptonotus, Laosaurus, Nanosaurus,* and in Europe *Hypsilophodon.*

(2.) Family *Iguanodontidæ.* Clavicles present; postpubis incomplete. Premaxillaries edentulous. Known forms all European.

Genera: *Iguanodon, Vectisaurus.*

(3.) Family *Hadrosauridæ.* Teeth in several rows, forming with use a tessellated grinding surface. Anterior vertebræ opisthocœlian.

Genera: *Hadrosaurus, ? Agathaumas, Cionodon.*

(4.) Order Theropoda (Beast-foot). Carnivorous.

Feet digitigrade; digits with prehensile claws. Pubes projecting downward, and coossified distally. Vertebræ more or less cavernous. Fore limbs very small; limb-bones hollow. Premaxillaries with teeth.

(1.) Family *Megalosauridæ.* Vertebræ biconcave. Pubes slender, and united distally. Astragalus with ascending process. Five digits in manus, and four in pes.

Genera: *Megalosaurus* (*Poikilopleuron*), from Europe; *Allosaurus, Cœlosaurus, Creosaurus, Dryptosaurus* (*Lælaps*).

(2.) Family *Zanclodontidæ.* Vertebræ biconcave. Pubes broad elongate plates, with anterior margins united. Astragalus without ascending process; five digits in manus and pes. Known forms European.

Genera: *Zanclodon, ? Teratosaurus.*

(3.) Family *Amphisauridæ.* Vertebræ biconcave. Pubes rodlike; five digits in manus, and three in pes.

Genera: *Amphisaurus* (*Megadactylus*), *? Bathygnathus, ? Clepsysaurus,* and in Europe *Palæosaurus, Thecodontosaurus.*

(4.) Family *Labrosauridæ.* Anterior vertebræ strongly opisthocœlian and cavernous. Metatarsals much elongated. Pubes slender, with anterior margins united.

Genus *Labrosaurus.*

Suborder Cœluria (Hollow-tail).

(5.) Family *Cœluridæ.* Bones of skeleton pneumatic or hollow. Anterior cervical vertebræ opisthocœlian, remainder biconcave. Metatarsals very long and slender.
Genus *Cœlurus.*

Suborder Compsognatha.

(6.) Family *Compsognathidæ.* Anterior vertebræ opisthocœlian. Three functional digits in manus and pes. Ischia with long symphysis on median line. Only known specimen European.
Genus *Compsognathus.*

DINOSAURIA ?

(5.) Order Hallopoda (Leaping-foot). Carnivorous ?

Feet digitigrade, unguiculate ; three digits in pes ; metatarsals greatly elongated ; calcaneum much produced backward. Fore limbs very small. Vertebræ and limb-bones hollow. Vertebræ biconcave.
Family *Hallopodidæ.*
Genus *Hallopus.*

The five orders defined above, which I had previously established for the reception of the American Jurassic Dinosaurs, appear to be all natural groups, well marked in general from each other. The European Dinosaurs from deposits of corresponding age fall readily into the same divisions, and, in some cases, admirably supplement the series indicated by the American forms. The more important remains from other formations in this country and in Europe, so far as their characters have been made out, may likewise be referred with tolerable certainty to the same orders.

The three orders of herbivorous Dinosaurs, although widely different in their typical forms, show, as might be expected, indications of approximation in some of their aberrant genera. The Sauropoda, for example, with *Atlantosaurus* and *Brontosaurus* of gigantic size for their most characteristic members, have in *Morosaurus* a branch leading toward the Stegosauria. The latter order, likewise, although its type genus is in many respects the most strongly marked division of the Dinosaurs, has in *Scelidosaurus* a form with some features pointing strongly towards the Ornithopoda.

The Carnivorous Dinosauria now best known may all be placed at present in a single order ; and this is widely sepa-

rated from those that include the herbivorous forms. The two suborders defined include very aberrant forms, which show many points of resemblance to Mesozoic birds. Among the more fragmentary remains belonging to this order, but not included in the present classification, this resemblance appears to be carried much further.

The order Hallopoda, which I have here referred to the Dinosauria, with doubt, differs from all the known members of that group in having the hind feet especially adapted for leaping, the metatarsals being half as long as the tibia, and the calcaneum produced far backward. This difference in the tarsus, however, is not greater than may be found in a single order of Mammals, and is no more than might be expected in a subclass of Reptiles.

Among the families included in the present classification, I have retained three named by Huxley (Scelidosauridæ, Iguanodontidæ, and Megalosauridæ*), although their limits as here defined are somewhat different from those first given. The suborder Compsognatha also was established by that author in the same memoir, which contains all the more important facts then known in regard to the Dinosauria. With the exception of the Hadrosauridæ, named by Cope, the other families above described were established by the writer.

The Amphisauridæ and the Zanclodontidæ, the most generalized families of the Dinosauria, are only known from the Trias. The genus *Dystrophæus*, referred provisionally to the Sauropoda, is likewise from deposits of that age. The typical genera, however, of all the orders and suborders are Jurassic forms; and on these especially the present classification is based. The Hadrosauridæ are the only family confined to the Cretaceous. Above this formation there appears to be at present no satisfactory evidence of the existence of any Dinosauria.

XII.—*On a small Collection of Lepidoptera from Melbourne.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

The present series consists of ninety-one examples, some of them unfortunately in very poor condition, forwarded to us from Australia by Dr. T. P. Lucas. Notwithstanding that not a few of the specimens are more or less worn or broken,

* 'Quarterly Journal Geological Society of London,' vol. xxvi. p. 34, 1870.

there are many species among them which are new to the national Collection, and some hitherto unknown to science. The following is a list of the species.

RHOPALOCERA.

Nymphalidæ.

SATYRINÆ.

1. *Geitoneura Klugii*, Guérin (386).

A male specimen.

Lycænidæ.

2. *Polyommatus bæticus*, Linn. (72).

A male.

3. *Lampides ? palemon*, Cram. (73).

A male.

4. *Lycæna phœbe*, Murray (75).

A female.

5. *Lucia limbaria*, Swains. (391 and 400).

A pair.

6. *Ialmenus icilius*, Hewits. (68).

A male.

Hesperiidæ.

7. *Telesto flammeata*, sp. n. (383).

Near to *T. donnysa*, but smaller, the costal margin of primaries shorter ; spots of primaries as in *Plesioneura dan*, the two spots on the median interspaces being placed at the base of these areoles, and therefore only separated from the quadrate subcostal spot by the median vein and second median branch, which are dark brown ; the interno-median spot also being obsolete ; the three subapical spots are smaller, the two upper ones being reduced to mere points ; the ground-colour is chocolate-brown, the basal two fifths clothed with olivaceous hair-scales ; spots hyaline stramineous ; fringe tipped with ochreous, excepting at external angle, where it is white : secondaries as in *T. donnysa*, excepting

that they are shorter and that the fringe is tipped with ochreous instead of white: body clothed with paler and greener hairs. Wings below more clay-coloured, and with a pink gloss; the primaries with spots as above, the dark discoidal area more restricted and not so black: secondaries with the spots dark brown, the discal series interrupted, owing to the absence of any spot on the lower radial interspace: body below yellowish white; legs pale reddish-clay-coloured. Expanse of wings 35 millim.

One example.

Hewitson's figure of *T. donnysa* is not characteristic, the spots on the primaries being smaller and less quadrate than usual, and the patch on the secondaries larger; this patch is usually confined to the radial interspaces, the median spots being small and concealed by the olivaceous hairs which clothe the basi-abdominal third of the wing.

8. *Telesto eclipsis*, sp. n. (387).

Wings above chocolate-brown, shot with bronzy green: primaries with the basal half densely clothed with ochreous hair-scales; basal half of third median branch velvet-black; a large circular velvet-black spot, bounded internally by a lunate hyaline whitish spot at the base of the first median and the middle of the interno-median interspaces; an oval hyaline whitish spot at the end of the cell, a second at the base of the second median interspace, and three dots on the subcostal interspaces (as in the preceding species): secondaries with the discoidal area almost to outer margin densely clothed with ochreous hair-scales, and the median and interno-median areas almost to outer margin with olivaceous hair-scales; a slender greyish marginal line: fringe of primaries tipped with whity brown, that of secondaries with ochreous: body clothed with greenish hairs, anal tuft ochreous at tip. Under surface of wings yellowish-clay-coloured: primaries with the internal half grey, becoming blackish close to the median vein; a hyaline oval spot at the end of the cell, a second near the base of the second median interspace, and a small dot on the last subcostal interspace; a slender brown marginal line; fringe brown, with a pale basal line: secondaries with a small dark-brown spot at the end of the cell, and a slightly irregular arched series of six spots on the disk: body below greenish white; legs brown above, the femora and tibiæ with a greenish-white line below the tarsi, below pale brown. Expanse of wings 35 millim.

A male.

9. *Telesto compacta*, sp. n. (95).

Allied to *T. Doubledayi* (*T. dirphia*, Hew.). Primaries above darker, but with the same pattern, excepting that the fringe is clay-coloured spotted with black: secondaries dark purplish brown, clothed towards the base with greenish hairs, and crossed in the middle by an abbreviated series of four yellowish-white hyaline spots; four smaller spots are placed nearer the base, two in the cell, and two on the first subcostal interspace; fringe clay-coloured: body densely clothed with green hairs. Wings below reddish clay-coloured; hyaline spots nearly as above, but rather more numerous in appearance, some sericeous white spots being added: primaries with the margins of the ⊏-shaped discoidal marking and a broad patch crossing the median interspaces black; internal area grey; fringes as above: body below greenish white; tarsi clay-coloured. Expanse of wings 27 millim.

A male.

10. *Taractrocera papyria*, Boisd. (4).

A male.

Heterocera.

Zygænidæ.

11. *Procris dolens*, Walk. (314).

A worn male.

Lithosiidæ.

12. *Deiopeia pulchella*, Linn., var. *lotrix*, Cramer.

One poor specimen of this variety.

13. *Termessa læta*, Walk.

A broken example.

Liparidæ.

14. *Porthesia melanosoma*, sp. n. (357).

Snow-white; antennæ with greyish-brown pectinations; abdomen black, with snow-white anal tuft; anterior femora blackish above; anterior tibiæ above ochreous: primaries below with the base of costal border blackish. Expanse of wings 32 millim.

A male.

We have two female examples in the Museum of an allied species from Tasmania. They are snow-white, with black abdomen as in *P. melanosoma*; but the anal tuft is bright orange, and there is no blackish colouring at the base of the primaries on the under surface. One of these specimens is labelled "*mixta*" by Walker; and therefore the species may take that name.

15. *Teia pusilla*, sp. n. (287).

Teia anartoides, var. *β*, Walker, Cat. Lep. Het. iv. p. 804 (1855).

Smaller than *T. anartoides*; primaries redder, with fewer greyish-white scales; secondaries with slightly narrower black border. Expanse of wings 21–30 millim.

A male without abdomen.

T. anartoides, which is confined to Tasmania, expands 33–34 millim., and seems constant to that size. There are five examples in the Museum; of *T. pusilla* we have seven specimens.

16. *Darala stygiana*, sp. n. (316).

Primaries above grey, or (when seen through a lens) black densely irrorated with white scales; a small black-edged white spot in the cell, connected by a longitudinal black line to a larger similar spot at the end of the cell; wing crossed by five zigzag black stripes, the first three near together before the middle, the last, acutely zigzag, submarginal: secondaries cream-coloured, changing at external third to ashen grey; base washed with testaceous; a straight blackish stripe across the basal third; an undulated blackish arched line at external third; a submarginal series of white dots; fringe of all the wings black, spotted with white: body black, with scattered white hairs; antennæ white, with grey pectinations; abdomen sericeous white, mixed with carmine hairs at the sides. Wings below white, sericeous; external third greyish; a slightly irregular black stripe just before the middle; a slender and slightly undulated discal blackish line, followed by a broad diffused grey belt with zigzag outer edge; fringe blackish, spotted with white: primaries with the discoidal area testaceous; a black-bordered white spot in the cell, and a second at the end of the cell; costal margin dusky: secondaries with a small blackish spot in the cell: thorax below brown in the middle and black at the sides, very hairy, and with scarlet and carmine hairs mixed in with the black and brown ones; legs above greyish brown, knees and end of tibiæ sulphur-yellow; anterior tibiæ clothed with pale yellow

hair above and with white hair below, amongst which is a long flattened digitate whitish process, with a black central bar; venter white. Expanse of wings 73 millim.

A male.

This insect came in such a greasy condition that the coloration was entirely altered; after soaking for five minutes in benzole the sides and under surface of the body changed from stramineous to white.

Apamiidæ.

17. *Mamestra confundens*, Walk. (363).

One example.

This species was described by Walker in one of his supplementary papers under the title of "Characters of undescribed Lepidoptera Heterocera."

18. *Miana Lucasii*, sp. n. (330).

Whity brown, sericeous: wings with a slender black marginal line, interrupted at the extremities of the veins: primaries clouded with greyish brown; costal border whitish to apical fifth, but crossed by black lines; submedian vein, median, and its first two branches white; a rust-red stripe running longitudinally through the interno-median area; external border snow-white, with deeply dentate-sinuate internal edge; fringe pale red-brown; orbicular spot small, rust-red, with black margin; reniform spot with its lower half prolonged, dark brown, with blackish-edged orange inner border and snow-white ➤-shaped outer border, below the inferior extremity of which is a small white dot; a slightly irregular denticulated externally buff-bordered black line across the disk, and three equidistant zigzag black lines between the end of the cell and the base: secondaries sordid white, with snow-white fringe; an oblique dusky discocellular dash, beyond which the wing is crossed by an indistinct denticulated brownish line, followed almost immediately by a similarly-coloured stripe: body whity brown, the thorax white, with pale-brown margins to the tegulæ and collar, a blackish spot on the middle of the frons. Wings below shining white, with a slight brassy tint; the surface, particularly of the secondaries, irrorated with brown; blackish discocellular spots; a slender interrupted marginal brown line: primaries with brown-tipped fringe: secondaries with a transverse series of little black dashes on the veins, followed by a brownish undulated submarginal stripe: body below white. Expanse of wings 33 millim.

One example.
This is a strikingly distinct and rather large species.

Noctuidæ.

19. *Agrotis Baueri*, Felder (347).

One perfect specimen.
An insect labelled No. 335 is too much broken and rubbed for identification; the abdomen is wanting, and the wings are worn and split.

Poaphilidæ.

20. *Phytometra tristis*, sp. n. (70).

Brownish grey; fringe of wings a little paler: primaries with four nearly equidistant white costal spots, the first at the outer edge of a broad dark-brown angular basal band, the second and third at inner and outer edges of a broad central band of the same character; a black spot at the end of the cell; margins of tegulæ and posterior margins of abdominal segments indistinctly whitish. Primaries below grey, sericeous; costal border creamy whitish at base; four dusky costal spots, the third and fourth of which are the commencement of two internally diffused, externally undulated, and whitish-bordered subparallel discal bands; fringe with a pale basal line; discocellulars black: secondaries greyish brown, with a slight pink tint, the basal three fourths almost entirely occupied by three internally diffused and externally white-bordered undulated oblique bronze-brown bands; fringe with a white basal line: body below white, irrorated with brown; legs brown above, white below. Expanse of wings 25 millim.
One male.

Urapteridæ.

21. *Idiodes mitigata*, Guénée (124).

One example.
This species is figured by Felder as *I. inspirata* of Guénée.

22. *Idiodes siculoides*, Walker.

A fragment.
Walker unnecessarily made a new genus (*Choara*) for this species; it does not differ in a single structural character from *Idiodes*.

Ennomidæ.

23. *Gynopteryx ada*, sp. n. (37).

Pale pinky brown, sericeous; wings mottled all over with slaty-grey striolations; fringe tipped with white: primaries with a nearly straight line, formed by the congregation of some of the grey mottlings, at basal third; an oblique grey line, with whitish external edge, from the inner margin to the costa near apex; this line is scarcely perceptibly angulated at the third median branch; a small blackish discocellular spot; a blackish stripe through the centre of the fringe: secondaries crossed by a slightly tapering discal grey stripe; basal area pale; abdomen paler than the thorax. Under surface pinky brown or pale copper-colour, speckled with black; black discocellular spots and a black discal line running to costa near apex on all the wings: primaries with some ash-grey mottlings on external area between the veins; pectus silvery whitish behind the legs. Expanse of wings 34 millim.

One example.

Boarmiidæ.

24. *Tephrosia exportaria*, Guénée.

One example.

25. *Tephrosia fractaria*, Guénée.

One broken example.

Geometridæ.

26. *Chlorochroma vulnerata*, sp. n. (128).

Bright emerald-green: primaries crossed in the middle by two whitish reversed zigzag lines, most nearly approximated on the interno-median interspace; secondaries with only one (the outer) line; fringe of all the wings carmine, tipped with pinky white; costal border of primaries carmine internally and white externally; a carmine spot at end of cell on secondaries: antennæ white, with carmine pectinations; head carmine, with a transverse white band on the vertex. Wings below paler than above, and without zigzag whitish lines: body below creamy yellow; the legs above and the terminal joint of the palpi carmine. Expanse of wings 26 millim.

A male.

This beautiful little species comes nearest to *C. externa*; but the fringe of the latter insect is pale sulphur-yellow at the base, and plum-coloured with black spots externally.

The *C. decisissima* of Walker is his *Geometra semicrocea*, the "*semicroceus*" coloration of which is due to fading.

27. *Chlorochroma carenaria*, Guénée (146).

A male.

Walker's *Geometra submissaria* consists of faded specimens of this species.

Acidaliidæ.

28. *Asthena ondinata*, Guénée (96).

One example.

29. *Asthena risata*, Guénée (116).

A broken specimen.

30. *Acidalia repletaria*, Walk. (67).

A broken example.

31. *Acidalia optivata*, Walk. (122).

One example.

Macariidæ.

32. *Macaria remotaria*, Walk., var. *frontaria*, Walk. (111).

One of the typical form, and one of the variety.

The *M. infixaria* and *M. porrectaria* of Walker are identical with *M. remotaria*.

33. *Macaria inconcisata.*

Panagra inconcisata, Walker (270).

One example.

I refer this species to *Macaria* in its unrestricted sense; it is possible, however, that when the whole of the species placed under this generic name are examined it may not be found to fall into the typical group.

Fidoniidæ.

34. *Panagra tryxaria*, Guénée (100).

One example.

35. *Panagra hypenaria*, Guénée (136).

One broken specimen.

36. *Panagra curtaria*, Guénée (86).

One specimen.

37. *Gorytodes? confluaria*, Guénée (19).

One example.

This species is a little aberrant for *Gorytodes*, the palpi being longer; Guénée's assignment of the species to *Panagra* is absurd.

38. *Gorytodes? graphicata*, Walker (520).

One example.

Certainly congeneric with the preceding species, but with shorter palpi; it was referred by Walker to *Tephrina*.

39. *Dasyuris metaxanthata*, Walk.

A male (no number given).

This species was referred by Walker to *Cidaria*.

Ligiidæ.

40. *Chlenias arietaria*, Guénée (275).

A male without abdomen.

Larentiidæ.

41. *Larentia clandestinata*, Walk. (14).

One injured specimen.

42. *Chrysolarentia conifasciata*, sp. n. (130).

Allied to *C. vicissata*. Primaries with the basal fourth dark brown, limited externally by a whitish line elbowed within the cell; next to this is a red-brown band; central area whitish, pyramidal, the widest part being at costa, its inner border traversed by two black lines, its outer, which is wider, by three golden-brown lines, and its centre, from costa to middle of interno-median interspace, by a broad dark-brown belt, wide on the costa, but tapering behind to an obtuse point; three externally acute blackish subapical spots in a transverse series; costal area at apex greyish brown; external area black internally, testaceous, clouded with grey externally, the two parts being divided by a central dentate-sinuate

whitish line, the apical portion obliquely rounded off internally, and limited by a white dash; a marginal black line, interrupted at the extremity of the nervures; fringe dark brown, with a pale basal line: secondaries bright ochreous, with black marginal line as on the primaries; fringe greyish brown, traversed by two pale lines; two brown streaks at anal angle, and a few small spots along the abdominal margin: body pale pinky brown; palpi and a double dorsal series of spots on the abdomen black. Under surface of wings testaceous, speckled with brown; a disco-submarginal squamose brownish band; a brown postmedian line, and a small black spot at the end of each discoidal cell; a very slender black marginal line; fringe grey, with a pale-yellow basal line: body below whitish, irrorated with brown. Expanse of wings 34 millim.

A female example.

The allies of this species have been referred to various genera: Guénée placed some of them (as *C. vicissata*) in *Coremia* and others in *Camptogramma*; Walker placed them under *Coremia* and *Cidaria*; and Felder referred them to *Cidaria* only. They seem to me to have greater affinity to *Larentia* than to any of these three genera; but the primaries are, as a rule, more acute, and the character of coloration, which may be roughly described as consisting of dark-brown primaries and ochraceous secondaries, is very different; the palpi, as in many genera of Geometrites, form a conical point in front of the head, the antennæ are pectinated in the males, but simple in the females. I would propose for this group the generic name of *Chrysolarentia*.

PHRISSOGONUS, gen. nov.

Allied to *Microdes*. Male with the costal margin of the primaries angulated at basal third and bearing a projecting tuft of short hairs, the whole central area of these wings very coarsely scaled on the under surface; antennæ of male thick and pubescent; venation quite simple; pattern like that of *Eupithecia*, which the female perfectly resembles.

43. *Phrissogonus canatus* (92).

♀. *Scotosia canata*, Walker.

A pair.

44. *Coremia? solutata*, Walk. (27).

One specimen.

In my opinion this species should be referred to *Larentia*.

45. *Coremia relictata*, Walk. (15).

One specimen without abdomen.

46. *Coremia cymaria*, Guénée (15).

One example without abdomen.

47. *Coremia? plusiata* (24).

Panagra plusiata, Walker.

One example.

48. *Coremia plurilineata* (299).

Panagra plurilineata, Walker.

One example.

49. *Coremia revulsaria* (305 & 307).

Panagra revulsaria, Walker.

Two examples.

50. *Camptogramma mecynata*, Guénée (526).

One worn female.

This species was subsequently described (twice in the same page) by Mr. Walker under the names of *C. extraneata* and *C. annuliferata*.

51. *Phibalapteryx scitiferata* (150).

Scotosia scitiferata, Walk.

One damaged example.

52. *Phibalapteryx glandulata*, Guénée (79).

One fairly good specimen.

This species should by right be generically separated from *Phibalapteryx*, on account of the glandular patch on the upper surface of the secondaries in the male.

Euboliidæ.

53. *Eubolia capitata* (89).

Tephrina capitata, Walk. (? = *flavicapitata*, var., Guén.).

One example.

54. *Eubolia? obtusata* (5).

Panagra obtusata, Walk.

One example.

This and the following do not quite agree in character with *Eubolia*, the style of pattern being more nearly that of *Camptogramma*, to which genus it may be necessary, after more minute structural examination, to refer them; the type of coloration approaches more nearly to that of *Anaitis* in some respects.

55. *Eubolia*? sp. n. (284).

The single example of this species, which seems to be a new form allied to *E. obtusata*, is broken and so much rubbed that it is impossible to describe it with any certainty.

56. *Eubolia linda*, sp. n. (21).

Sericeous ash-grey, the basal four fifths of the primaries washed with brown and crossed by two widely separated white lines, the inner one nearly straight and bordered externally with black, the outer one alternately biangulated, arched towards the costa and bordered internally with black; a black spot at the end of the cell; veins blackish on the disk; a marginal series of small black spots connected by an undulated grey line; fringe whitish at base: secondaries with a marginal series of black dots; two dark grey abbreviated discal lines on the abdominal area; head and thorax blackish. Under surface silvery grey. Expanse of wings 27 millim.

A male example.

Near to "*Panagra*" *atrosignata*.

Ennychiidæ.

57. *Rhodaria robina*, sp. n. (154).

Ochreous; wings above with a rather broad rosy ferruginous external border, more defined in the primaries than the secondaries, its inner edge limited by a line of the ground-colour enclosed by a dull reddish line; the primaries are also crossed by two other similar reddish lines, one crossing the extremity of the cell, and the other halfway between the latter and the base; the costal area reddish, with a continuous series of small, blackish-edged, semicircular, yellow spots along the costal margin; all the wings with a series of minute black dots along the outer margin; fringe rosy, crossed in the middle by an externally white-bordered plum-coloured undulated line. Under surface pale straw-yellow; a ferruginous external border separated by a line of the ground-colour from a red-brown discal line, dotted with blackish on the primaries and abruptly angulated close to costa, oblique and sinuous on the secondaries; a black marginal line; fringe rosy brown,

traversed by a central black line, and on the primaries tipped with white, the same wings with costal margin spotted as above, the discoidal area dark ferruginous, and the internal area dull white; venter with a lateral plum-coloured line. Expanse of wings 27 millim.

A male.

Scopariidæ.

Tetraprosopus, gen. nov.

Aspect and venation of *Scoparia*, but the maxillary palpi large and prominent and the labial palpi having the appearance of three pairs of palpi, the basal joint being ornamented with two compressed and dense pencils of hair, the upper one nearly as long as the body of the palpus and distinctly broader than it, the lower flat and tapering. Legs long and tolerably stout, the middle tibiæ with two unequal terminal spurs, the posterior tibiæ with two similar spurs at distal third.

58. *Tetraprosopus Meyrickii*, sp. n. (90).

Primaries above greyish brown, with longitudinal black streaks between the nervures; basal four fifths speckled with large white scales, which towards the inner margin almost obliterate the black streaks; the discoidal streak, which is broad, obliterated towards the base, and crossed near its outer extremity by a white spot; the edge of the white-speckled area is fairly well defined, oblique and zigzag towards the costa; outer border speckled with white so as to cut off the extremities of the discal streaks, and thereby produce a series of black marginal dots; fringe whity brown, traversed by two blackish lines: secondaries grey with blackish external area tapering towards the anal angle; costal border white; fringe sordid white, traversed by two lines, the inner one broad and blackish, the outer one grey: thorax blackish, irrorated with white; abdomen wanting in the type. Primaries below shining grey, with bronze reflections; costal border and a line at the base of the fringe cream-coloured: secondaries whiter than above, shining, with brassy reflections, otherwise similar; pectus, under surface of palpi, and the legs pearly white. Expanse of wings 26 millim.

One example.

In appearance and size this interesting species most nearly resembles the *Hypochalcia submarginalis* of Walker's Catalogue, which is a true *Scoparia*. I have named it in honour of E. Meyrick, Esq., a well-known worker at Australian Microlepidoptera.

Phycidæ.

59. *Mella chrysoporella* (35).

Etiella chrysoporella, Meyrick.

One specimen.

Crambidæ.

60. *Crambus lativittalis*, Walk. (51).

One specimen.

61. *Crambus relatalis*, Walk. (80).

One specimen.

62. *Crambus enneagrammos*, Meyrick (110).

One specimen.

63. *Crambus pleniferellus*, Walk. (157).

One specimen.

This is the *C. impletellus* of Walker, and *C. aurorus* of Felder and Rogenhofer.

Tortricidæ.

64. *Conchylis tasmaniana*, Walk. (114).

One specimen.

65. *Conchylis? subfurcatana*, Walk. (185).

One specimen.

66. *Conchylis thetis*, sp. n. (449*a*).

Silvery white; primaries above clouded with golden cupreous; markings fuliginous brown with reddish cupreous reflections, as follows—a spot on the interno-median interspace just before the basal third, two very oblique convergent abbreviated bands dividing the costal area into three equal parts, a marginal line and a line on the fringe: secondaries reticulated with greyish brown, a marginal line and a second near the base of the fringe of the same colour: palpi pearl-grey; base of antennæ and shoulders yellow. Primaries and body below pale bronze brown; secondaries silvery white. Expanse of wings 17 millim.

A male.

This species appears to me to belong to the *C. fulvana*

group, though its more acuminate primaries and white secondaries give it a somewhat different aspect.

67. *Penthina?*, sp. (449*b*).

The specimen is too much broken and rubbed for description; it is evidently regarded by the collector as a variety of the preceding: but the wings are not so broad; and the neuration, so far as I can make it out in the rubbed condition of the insect, appears to be that of *Penthina Schulziana*; the style of marking also is that of *Penthina*, the primaries (and not the secondaries) having a reticulated character. It is not unlike *Œcophora retractella* in its general aspect.

Hyponomeutidæ.

68. *Psecadia pretiosella*, Walk. (446).

One example without abdomen.

69. *Psecadia? radiosella*, Walk. (54).

One specimen.

This is the same as *Bida crambella.*

70. *Psecadia conductella*, Walk. (1).

One specimen.

Gelechiidæ.

71. *Œcophora semiruptella*, Walk. (118).

One specimen.

72. *Œcophora arabella*, Newman (455).

One specimen*.

* Confounded with this in the Museum series I find the following:—

Conchylis? auriceps, sp. n.

Primaries above golden ochreous; a subcostal stripe, an internal or dorsal stripe near the margin, a lunate oblique dash on the disk between the inferior angle of the cell and the external angle, a >-shaped marking beyond the cell (its upper ramus extending to apex and its lower one to outer margin), and the fringe leaden grey: secondaries dark bronze-brown: head orange-yellow, the frons dark leaden grey; thorax dark purplish grey, shining: abdomen brown, with whitish hind margins to the segments, terminal and lateral stramineous tufts. Primaries below bronze-brown, with a yellow apical spot; fringe leaden grey: secondaries straw-yellow, the anal half washed with grey: pectus below greyish, the legs and venter sordid cream-coloured. Expanse of wings 24 millim.

Between Sydney and Moreton Bay.

The specimen has unfortunately lost its palpi; so that I cannot be

73. *Œcophora bracteatella*, Walk. (36).

One example.

74. *Œcophora interlineatella*, Walk. (125).

One specimen.

75. *Tingena bifaciella* ?, Walk. (132).

One unusually large example.

76. *Cryptolechia carnea*, Zell. (184).

One specimen without abdomen.

77. *Cryptolechia triphœnatella*, Walk. (207).

One damaged specimen.

78. *Palparia aurata*, Walk. (283).

A damaged example.

79. *Symmoca? herodiella*, Felder (77).

One specimen.

The three following genera also appear to belong to this family, although I am a little doubtful about the first of them, the antennæ of which, being pectinated to the tips and rather long, seem somewhat aberrant for the Gelechiidæ. I believe, however, that the natural position of this little genus will be found to be near to *Cryptophasa*; and I now name it

CRYPTOPEGES, gen. nov.

Wings rather long, narrow, acuminate at apex; primaries truncated, with very slightly convex costal and dorsal margins and slightly oblique outer margin, grooved below the costal vein at base; discoidal cell very narrow and long, placed in the centre of the wing and divided by a recurrent vein; costal vein terminating at about the middle of the costal margin; subcostal emitting three parallel branches at equal distances before the end of the cell; a fourth branch, forked towards apex, emitted from the superior angle of the

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positive of the correctness of its generic location; although in colours it wonderfully resembles *Œ. arabella*, it differs in form, especially in the fringing of the wings and in neuration. I believe it to be a *Conchylis*.

cell; one radial vein; median emitting its three branches near together at the end of the cell; submedian normal; fringe rather short: secondaries triangular, with very long costal margin, short abdominal margin, and very oblique outer margin; frenum simple, rather long; costal vein extending nearly to apex; discoidal cell long and narrow; subcostal emitting its first branch close to the end of the cell, and its second from the superior angle; on the right-hand side in the type the radial is emitted from the second subcostal branch, but on the left side it springs from the discocellulars in the usual manner; median three-branched, the last two branches emitted from the same point at the inferior angle of the cell: thorax robust, smooth. Head smooth, about half the width of the thorax; palpi slender, falciform, erect, projecting for half their length above the front of the head; antennæ three fourths the length of the primaries, with long and cylindrical basal joint, pectinated or, more strictly speaking, setose on both sides (the bristles being directed towards the apex) from the base to the extremity, and slightly tapering. Anterior tibiæ setose or sparsely fringed.

80. *Cryptopeges fulvia*, sp. n. (279).

Primaries above purplish brown; secondaries orange-ochreous, with black-brown external border and abdominal fringe; body above bronzy blackish, antennæ bronze-brown; palpi whity brown; abdomen and most of the legs wanting. Primaries below greyish brown, the interno-basal area broadly ochreous; secondaries golden ochreous, with grey-brown external border; pectus shining plumbaginous grey; legs pearl-grey below, brown above and banded with blackish. Expanse of wings 16 millim.

One damaged specimen.

LATOMETUS, gen. nov.

Wings long, narrow, acuminate, with rather long fringes: primaries below deeply grooved below the base of the costal border; costal vein short, terminating before the middle of the margin; remaining veins arranged nearly as in the preceding genus: secondaries ovoid, forming an obtuse point at apex; first subcostal branch emitted at some distance before the end of the cell; other veins almost as in the preceding genus. Thorax very robust, smooth. Head about half the width of the thorax, rather roughly covered with short hair-scales; palpi long, ensiform, tapering, projecting for about twice its length beyond the front of the head; antennæ extending to about

the third fourth of the costal margin of primaries, rather slender and ornamented throughout their length by short setæ on both sides. Legs robust; the fore pair shortest, the hind pair longest, the latter with two unequal pairs of tibial spurs and a compressed fringe of rather long bristles; middle legs with a terminal pair of tibial spurs.

81. *Latometus pilipes*, sp. n. (117).

Primaries above shining cream-white, with a longitudinal subcostal olivaceous stripe from base to apex; a second very indistinct interno-median stripe and an abbreviated dorsal stripe; fringe pale testaceous or sordid buff: secondaries greyish brown, with bronze reflections: thorax greyish brown, with a few white scales, most numerous round the collar, and with a slight pearly gloss in certain lights; antennæ blackish; palpi pearl-white; abdomen wanting in the type. Wings below shining greyish brown; pectus plumbaginous grey, glistening; legs greyish brown, with the lower margins of the femora glittering golden opaline. Expanse of wings 21 millim.

One example.

Although this species appears to have some affinity to the preceding one, many of its structural characters being similar, it bears no resemblance to it in the form and coloration of its wings, which are more like those of *Coleophora*.

ZACORUS, gen. nov.

Aspect of *Sciaphila* (*S. Gouana*); wings of the same general size and form; neuration quite different. Primaries below grooved at base of costal vein, as in the two preceding genera; costal vein extending to beyond the middle of the margin; subcostal with five branches, of which the first three are emitted before the end of the cell, and the last two from a long footstalk emitted from the anterior angle of the cell; radial emitted from the discocellulars as usual; three median branches emitted near together at the inferior extremity of the cell; submedian normal. Secondaries with similar venation to that of the two preceding genera, excepting that the first median branch is emitted further from the two others. Thorax very robust, smooth. Head rather woolly, but with the soft hair projecting forwards and smooth on the vertex; palpi very long and ensiform, projecting obliquely about five times the length of the head beyond the front of it; antennæ slender, simple, extending to about three fifths of the length of the costal margin of primaries. Abdomen smooth, sericeous. Legs rather robust, the femora compressed; posterior legs with the tibial and tarsal joints fringed at the extremities with stiff short bristles.

82. *Zacorus carus*, sp. n. (11).

Primaries and thorax above shining silvery white; secondaries and abdomen shining lilacine grey. Under surface shining greyish brown, with silvery whitish fringes. Expanse of wings 27 millim.

One example.

This is a very pleasing little moth, which at first sight might almost be mistaken for *Sciaphila Gouana*; it is, however, allied to the preceding genera and to *Œcophora*.

XIII.—*Descriptions of two new Species of* Papilio *from North-eastern India, with a Preliminary Indication of an apparently new and remarkable Case of Mimicry between the two distinct Groups which they represent.* By J. Wood-Mason, Deputy Superintendent, Indian Museum, Calcutta, on Special Duty with the Government of India.

1. *Papilio sikkimensis*, n. sp.

♂. Anterior wings oval, with the outer margin regularly rounded, and not in the least degree scalloped; above greenish black, with the base, the costal margin, cellular streaks, the folds of the membranous interspaces between the veins, and the veins narrowly bordered on both sides by intense velvety black, with the wing-membrane between the streaks and between the veins and black folds peppered regularly and rather sparsely with minute elongated whity-brown scales, and with the short cilia pure white, broadly but almost imperceptibly intersected by black.

Posterior wings elongated and narrow, each with a well-developed spatuliform "tail" in the usual position; above with the basal half green-black, the rest of the organs being intense velvety black, with a conspicuous cretaceous-white patch situated immediately beyond the end of the cell, and divided by the black-bordered veins into three parts or spots—one, large and subfusiform, between the second and third median veinlets, another between the third median veinlet and the discoidal vein, still larger and filling the basal half of the space, and a third, more or less than one third the size of the first, between the discoidal vein and the second subcostal branch, just before the middle of the space and of the second spot; each of these spots irrorated at the edges with red scales, especially externally and below, with a marginal and wavy submarginal series of four rich deep violascent red

lunules; the first of each series in the submedian interspace with a red spot of a paler tint than the rest, and divided into two unequal parts by the vein at the very end of each tail, and with the short incisural cilia cretaceous white.

Anterior wings below much paler, rich deep violascent red at base.

Posterior wings below coloured and marked as above, except that they are red at base, like the anterior ones, that this red extends backwards over the membranous interval between the submedian vein and the median and its first branch to a little beyond the level of the outermost cretaceous white spot, that the lunules are larger and brighter, that the two marginal lunules next the anal angle are each so joined to the one opposite to it in the submarginal series as to include a patch (the first roundish and the second lunular and double the size) of the black ground-colour, that there is a faint indication of a whitish lunule, the remains of a fifth (sometimes fully-developed and red) submarginal lunule beyond the anterior white spot, and that the incisural cilia are apparently longer. Antennæ black.

The setose clothing of the head, two longitudinal dorsal stripes from the head onto the pronotum, some of the setæ of the leg-bases and thorax below, and the outer ends of the abdominal terga *ferruginous*, passing on the frontal tuft into red very similar in tint to that of the lunules and wing-bases.

Nearly allied to *P. bootes*, Westwood, from the southern slopes of the Khasia Hills, but differing from it in having only two spots (the outermost and smallest being absent) in the cream-coloured patch, in having the red at the bases of the posterior wings extended far into the interspace between the submedian and median veins (in one specimen it has coalesced with the submarginal lunule), and the divided spot quite at the extremity of the slenderer tails of the apparently narrower posterior wings.

♀. Unknown.

Hab. Sikkim Hills. Four specimens, three from the collections of the late Mr. L. Mandelli, and one purchased. Also two specimens in the collection of Major G. F. L. Marshall, R.E.

Belongs, with *P. bootes*, *P. rhetenor*, *P. janaka*, and *P. scarius*, to the scentless *Protenor* group of *Papilio*, and not to the strong-scented and nauseous *Philoxenus* group, which it only mimics, its model being the same species as that of its Khasia-Hill ally, namely the *P. polyeuctes* of Doubleday, from the same region.

Obs. Papilio icarius, Westwood, is the female of the same

author's *P. rhetenor*; and it mimics Moore's *P. dasurada*, which occurs with it in the Sikkim, Khasia, and Cachar hills.

Papilio janaka, Moore, exactly copies *P. minereus*, G. R. Gray, from Sikkim and the adjoining region of Nepal.

P. boötes, Westwood, presents a similar mimetic resemblance to the *P. polyeuctes* of the Khasia hills.

The interesting and, so far as I have been able to discover, hitherto unrecognized case of mimicry indicated above will be fully described and illustrated in my forthcoming "Notes on the Phenomenon of Mimicry, as exemplified by the Papilionidæ of our North-eastern Indian Possessions."

2. *Papilio Nevilli*, n. sp.

Papilio, n. sp.?, G. Nevill, List Diurn. Lep. Ind. Mus. Calc. 1871, p. 1. no. 7.

Nearly allied to *P. ravana*, Moore, from Kulu, in the North-west Himalayas, but smaller, with the well-developed tails not constricted at the base.

♂. Posterior wings above with two large pink-white spots, one between the discoidal vein and the second branch of the subcostal, occupying all but the two ends of the space; the other in the space next in front, smaller and not extending so far towards the base of the space, and with three bright crimson submarginal lunules, two subequal in the interspaces between the branches of the median vein, and the third between the third median veinlet and the discoidal vein, equal to, or slightly greater than, the other two taken together; below with a small pink-white spot between the first branch of the subcostal and the costal veins, forming with the two visible on both sides of the organs a series of three, all equally distinct from the outer margin, the submarginal lunules larger and subequal and much lighter coloured, and with a fourth rather irregularly-shaped crimson spot, subequal to the lunules and divided into two unequal parts by the submedian vein, at the end of the basal half of which it is placed, with the tails well developed, but not constricted at base.

Hab. The vicinity of Silchar, Cachar. The three specimens before me were obtained many years ago by one of the native collectors of the museum, under the late Mr. N. T. Davey, of the Topographical Survey of India.

This species will be figured in my paper on the large collection of butterflies formed by me during the past hot season in Cachar.

Obs. P. ravana and *P. minereus* are both perfectly distinct from *P. philoxenus*, *P. polyeuctes* being perhaps only a variety of it.

XIV.—*Contributions to the Knowledge of the* Amœbæ. By Dr. August Gruber*.

[Plate IX.]

Auerbach†, as is well known, starting from the assumption that a membranous boundary was a necessary attribute of a cell, set up a theory, quite intelligible under the circumstances of the time, according to which the *Amœbæ* also, as unicellular creatures, had a membranous envelope. This opinion was refuted by subsequent naturalists; and it was Greeff‡ principally who gave a more correct interpretation of Auerbach's observations. With the overthrow of this theory, however, some forms of *Amœbæ* and many of the phenomena of their sarcode-body, well known to and very distinctly figured by Auerbach, although not quite rightly interpreted by him, seem to have been thrown into the background.

This refers to two *Amœbæ* whose bodies appeared to be surrounded by a double-contoured fine envelope, and which were described under the names of *Amœba bilimbosa* and *Amœba actinophora*. They were afterwards again mentioned by Hertwig and Lesser§, and regarded as identical with their *Cochliopodium*, which, however, as I shall hereafter show, can hardly be the case. We must also accept similar conditions for Greeff's || genus *Amphizonella*, as distinctly appears from his figure (fig. 18) of the colourless species.

The existence of a fine layer of clear protoplasm round the *Amœba*-body, which must be penetrated by the pseudopodia, seems to me to be by no means an insignificant phenomenon; and I hope to excite some interest by citing another form of *Amœba* of the same kind and by a fresh investigation of Auerbach's *Amœba actinophora*.

1. *Amœba tentaculata*, sp. n.

I found the *Amœba* which forms the subject of the following consideration in the small sea-water aquarium of the Zoological Institute here [Freiburg im Br.]. The water and the vegetable and animal organisms contained in it are chiefly derived

* Translated from the 'Zeitschrift für wissenschaftliche Zoologie,' Band xxxvi. pp. 459–470.

† Auerbach, "Ueber Einzelligkeit der Amöben," Zeitschr. f. wiss. Zool. Bd. vii.

‡ Greeff, 'Ueber einige in der Erde lebenden Amöben und andere Rhizopoden.'

§ Hertwig und Lesser, "Ueber Rhizopoden und ihren verwandte Organismen," Arch. f. mikr. Anat. Bd. x. Supp.

|| Arch. f. mikr. Anat. Bd. ii.

from the Frankfurt aquarium. But this spring I brought with me some bottles of sea-water with living contents from the Baltic coast and from the harbour of Genoa, and mixed this with the rest, so that I am by no means in a position to furnish the habitat of the creature that will here be described. The marine Protozoa, or at any rate those of the coast-fauna, seem, however, to be tolerably cosmopolitan; and we may therefore assume for *Amœba tentaculata* a wide distribution in our seas*. If I beat fragments of a seaweed upon the object-slide, or scraped off a little of the crust deposited on the glass wall of the aquarium, some specimens of the *Amœba* almost always made their appearance.

It forms a little mass of very variable size. The smallest examples measured about 0·03 millim., the largest 0·12 millim. In consequence of its greater refractive power, the body stands out luminously from the water, a property which, in the protoplasm of all Rhizopoda, goes hand in hand with greater viscosity. Here also we find the rule confirmed; for the protoplasm of *Amœba tentaculata* is, in fact, an extremely tenacious mass, in comparison with that of allied creatures.

Under a low power (about 80 diameters) we can see no movement or change of form in the animal; and it is only when we employ high and very high powers that we can convince ourselves that we have before us an *Amœba* the form of which is engaged in a continual although sluggish change. We shall soon see that the apparently motionless animal is really capable of locomotion, and may pass into a flowing state, distinctly recognizable under high powers.

But if we first of all examine the creature in the resting state, in which it generally is when it has not long been placed on the object-slide, the *Amœba* has then essentially the same form as an *Amœba verrucosa*; i. e. the whole body is, as it were, shrunk together, with its surface covered with elevated knobs and deep folds, which slowly change their form and position.

In the interior the vital activity of the protoplasm is manifested by a streaming and trembling movement of the fine dark granules with which the sarcode is abundantly furnished.

So far there would be nothing remarkable to observe in the

* Last spring I found my *Cothurnia operculata* (Zeitschr. f. wiss. Zool. Bd. xxviii.) in the harbour of Genoa, whilst the former examples were derived from the Frankfort aquarium, and therefore from northern seas. The same aquarium also contained *Cothurnia socialis*, referred to as cited above; and this I quite recently discovered in abundance upon fragments of Hydrozoa brought from the Baltic.

behaviour of *Amœba tentaculata*, and its conditions would perfectly agree with those occurring in *A. verrucosa*, which is so abundant and has been so often described.

But while in the latter we miss true pseudopodium-formation, both in the resting state and during flow, we are surprised here by seeing fine protoplasmic filaments make their appearance at different parts of the body. These are thin processes of equal breadth throughout, which stand out from the body, sometimes in one place, sometimes in another, and bend to and fro as if feeling about, often curve into a bow, but generally remain extended pretty straight. It first struck me that these pseudopodia did not, as in other *Amœbæ*, spring from the protoplasmic body in the shape of fingers gradually becoming thinner, but that small conical elevations of the body served as their base, and that they rose from these with a distinctly marked separation. When such pseudopodia with their supports were very numerous, they gave the *Amœba* a very peculiar appearance, which I have attempted to represent in fig. 1.

The business now was to discover a reason for the peculiar behaviour of the pseudopodia; and in this I very soon succeeded by the employment of immersion systems (Hartnack, No. X. or Seibert homogeneous imm.). It proved that the whole *Amœba* is enveloped by a fine layer of denser substance, consequently a membranaceous cortical layer, which causes the periphery of all its humps and processes to appear distinctly double-contoured.

In the case of the terrestrial Rhizopods like *A. tentaculata* described by Greeff *, the idea of a similar tougher cortical layer could not be avoided, as also in that of *Amœba verrucosa*, which is so often mentioned. In the case of the latter, indeed, I did not succeed in detecting any thing of the kind; but Leidy † says, "A striking peculiarity of *Amœba verrucosa* is, that the outlines of the body, the pseudopodal expansions, and the wrinkles of the surface often appear defined with partial or interrupted double lines, as if the animal were invested with a delicate membrane (pl. iii. figs. 1, 2, 7, 28, 29)." It is, however, certainly such a membrane, or rather membranaceous thickening of a fine cortical layer, that we find in *Amœba tentaculata*.

Directly within this firmer envelope lies the soft internal sarcode-mass! If a pseudopodium is to be pushed forth, the enveloping layer must first be broken through. This, however, offers some resistence, and is consequently pushed out in

* Archiv f. mikr. Anat. Bd. ii.

† Leidy, 'Freshwater Rhizopods of North America,' p. 55.

a conical form*. An aperture is broken through at the apex of the cone; and the sarcode issues in the form of a thin filament. Fig. 8 may serve to illustrate this process; in it we see distinctly the thin cortical layer (*b*) of the pseudopodial cone, and also within it the central substance (*m*), which is pushed forth as a pseudopodium (*p*) at the apex.

I succeeded in observing very distinctly the retraction of the pseudopodium, after which a new one frequently issued from the same cone. I also believe that I have often seen the issue of two pseudopodia simultaneously.

The pseudopodial cones have a very constant form; and although they can obliterate themselves again completely, this does not always take place after the retraction of the pseudopodium; but very frequently the elevation persists afterwards, and a small crater seems to have been formed at the spot where the orifice for the pseudopodium was situated (see fig. 2, *k*). I once found a specimen on which there were many pseudopodial cones, but all without processes (fig. 4, *k*); nevertheless they persisted, without alteration, for a considerable time.

I said above that the pseudopodia which are produced in this way bend slowly to and fro, a movement which they have in common with those of other *Amœbæ*. Whether they act as tactile organs, or are destined to bring in food, I cannot definitely state. The former, however, appears to me more probable; for we find in the interior nutritive materials, such as Diatoms, Algæ, &c., which are much too large to be capable of penetrating through the narrow aperture of the pseudopodial cone †.

At any rate the animal, notwithstanding its firmer enveloping layer, is able to take in solid materials. Moreover we know very nearly allied forms, such as *A. verrucosa*, which are destitute of these organs, and nevertheless take in such nutritive bodies. Sometimes it appeared to me as if a slow locomotion was effected by means of the pseudopodia, but only to very inconsiderable distances.

In advancing *A. tentaculata* employs no special organ any more than its allies which possess a firm cortical layer. The form in which we have hitherto considered it characterizes only the resting state of the *Amœba*. We soon see movement

* Conical elevations have also been described in *Podostoma filigerum*. It is even said that a sort of buccal aperture occurs in them; but this requires confirmation. At any rate, they may be referable to the structures before us. Moreover protrusions of similar appearance may very probably occur in other *Amœbæ*. (See also Auerbach, *loc. cit.* fig. 15.)

† Somewhat as in *Podostoma*.

taking place in the main mass itself; the humps and folds gradually disappear, the pseudopodia are for the most part drawn in, and with them the cones; and after the surface has become smooth, there commences a steady flow in one direction, exactly in the same manner as has long been known in *A. verrucosa*, although much slower. In the latter this stage was for a time regarded as forming a distinct species under the name of *A. quadrilineata*.

The longitudinal folds which gave origin to this name, and which are produced by the strain on the tenacious outer layer acting in one direction, occur here just in the same manner (figs. 5, 6, & 7). Along them we see the granules hastening forward in several streams, whilst a clear mass of protoplasm, free from granules, in constant flow moves on before them. A remarkable circumstance is that on the leading part of the body pseudopodia with their cones frequently persist, and thus, to a certain extent, may act as extended feelers (fig. 7).

While at the posterior end, *i. e.* at the part opposite to that which is pushing forward, the double contour is distinctly preserved in the outer layer, it disappears entirely on the anterior part (fig. 6), from which we must conclude that the first-mentioned part of the body retains its toughness, whilst anteriorly all becomes in flux, *i. e.* the more fluid constituents collect there. Nevertheless even these still have considerable density, as is proved by the pseudopodia and pseudopodial cones protruded from them, on which, however, no double contour is visible. Frequently a zone of clear protoplasm seems to surround the whole body; and then the double lines are no longer seen anywhere.

Of a nucleus nothing is to be seen while the *Amœba* remains in the resting state and the folds of the surface obstruct the view of the interior. But if the Rhizopod begins to move, when the body flattens itself completely, the nucleus at once becomes distinctly visible (*n* in the figures), and appears as a little disk surrounded by a narrow border, as in most *Amœbæ*. No contractile vacuole is present, a new proof of the still unexplained fact that this structure is wanting in the marine Rhizopoda.

2. *Amœba actinophora*, Auerbach.

The Rhizopod that is to be described here is a very small *Amœba*, measuring 0·03–0·04 millim., which occurred pretty plentifully in all sorts of receptacles of water in the neighbourhood of Lindau. It excited my interest because it seemed to have much in common with the *Amœba tentaculata* that I had previously observed; and, in fact, it proved that it

was exceedingly suitable for the completion and elucidation of the observations made on the latter.

I had already completed my observations and made the drawings which are here given before I could procure the literature which showed that the form in question was nothing else than Auerbach's *Amœba actinophora.*

A comparison of the figures given by this naturalist with mine shows how closely we are in agreement as to external characters; and that I have, notwithstanding, reproduced my drawings is in order that they may illustrate the point in which I differ from Auerbach, namely the behaviour of the outer membranous cortical layer, which here especially interests us. In accordance with this I also give the description in such a manner that it may represent the observation as I then made it, uninfluenced by any thing previously known.

The first striking point was that here also the protoplasm was distinctly surrounded by a double contour, and the animal appeared as if covered by an envelope.

The periphery was for the most part perfectly smooth, and only at one point did the animal extend a larger or smaller number of lobate pseudopodia. In this way the *Amœba* acquired delusively the appearance of a thalamophorous Rhizopod, with a closely-fitting thin carapace, from the orifice of which processes protruded. A glance at fig. 9 will explain this better than a detailed description. In this condition the protoplasm in the interior forms a tolerably compact mass, in which there are a number of rather large strongly-refractive granules.

When the number of the pseudopodia is large, so that a whole tuft of them protrudes at once (fig. 9), we see nothing of the cortical zone at their place of issue; it is entirely displaced. It is otherwise when only a few, say two or three, processes are pushed forth. The relations of the marginal layer are then quite distinctly visible, and we find that, just as in *A. tentaculata*, the cortex is pushed out into a cone, at the apex of which the pseudopodium makes its way out. Here, therefore, the double contour is also produced by a more tenacious layer surrounding the animal, which must be penetrated by the protoplasmic processes before they can issue (fig. 14). Even in the previously described form, however, we saw that we have not to do with a persistent membranous structure, but that during the flow of the animal the cortical layer becomes amalgamated with the rest of the sarcode. This is much more distinctly observable in *Amœba actinophora*. Thus all at once we see how, as the animal changes its form, the pseudopodia are at the same time nearly all

retracted, the body becomes flattened, the cortical zone vanishes and flows into a broad border of clear protoplasm, which surrounds the darker richly granular mass in the centre of the animal (figs. 11 & 12, *h*). The latter often remains for some time sharply discriminated from the hyaline border (fig. 17); but the boundary is soon obliterated, exactly as during the formation of an ordinary pseudopodium (fig. 12). In this state the nucleus (*n*) also becomes quite distinctly visible, agreeing precisely in its structure with those of other *Amœbæ*.

The melting of the fine cortical layer into the broad clear border does not take place with equal rapidity at all points; so that a part of the *Amœba* often appears sharply limited, whilst another is already surrounded by the clear space (fig. 11, *r s*). In fig. 14, for example, is represented an *Amœba diffluens*, one side of which is already quite liquefied, while on the other half the double-contoured enveloping layer is still retained, and on it even two pseudopodial cones, with the processes issuing from them, are still visible. Fig. 15 is also instructive in another way. There the cortical layer has become fluid, and we see that the two pseudopodia which have persisted consist of the same hyaline protoplasm as the clear border in which the cortical zone previously sharply separated from it (see fig. 14) has dissolved itself. In the first state, therefore, there would have been an envelope and an endoplasm enclosed by it, and from which the pseudopodia proceeded, clearly distinguishable; in the latter both have become fused into one. Rapidly as the broad, scarcely visible border had formed, it can just as rapidly contract itself again; it shrinks to a certain extent together, until the narrow cortical layer again originates from it.

In this way *Amœba diffluens* can continually change its aspect completely in one or other of the modes described. Upon what law this power depends cannot be stated definitely; very probably, however, different conditions of pressure come into play in the matter. With a centripetal pressure acting uniformly upon the whole periphery, the more fluid parts of the protoplasm are all pressed into the interior, and only the narrow membranaceous boundary remains. This acquires a firmer consistence by contact with the water; and therefore at the points where pseudopodia issue it is pushed aside by the latter. If the general pressure ceases, the more fluid constituents again come forth from the interior, dissolve the solidified cortical layer, and form the clear border.

The best illustration of this explanation of the process is furnished by those cases in which a slow flowing forward of

the *Amœba* in one direction is taking place (fig. 14). On the advancing side the fluid constituents are pushed on in front; here all pressure has ceased, whilst it acts upon the opposite side, where, accordingly, the cortical contours are quite distinctly to be seen.

Auerbach had also observed this liquefaction into a disk, as is shown by his fig. 8; but he conceived of it as a phenomenon of expansion in which the cell-membrane also had to take part; but we now know that no such membrane exists, and that the envelope is to be regarded only as a transitory concentration of the outermost layer of sarcode, and can at any time dissolve again (see fig. 11).

Taking into consideration some other forms belonging here, *Amœba bilimbosa* of Auerbach is the first to be mentioned. I do not think that it is identical with those just described; the very distinct figures given by the discoverer (plate xix.), the difference of size, and several other differences are opposed to such a notion. In this case nothing is said of a disappearance of the cortex; and this reminds us more of the conditions stated by Greeff (*loc. cit.*) to occur in his *Amphizonella digitata* (fig. 18).

Special interest also attaches to *Cochliopodium pellucidum* of Hertwig and Lesser *, which so closely resembles *A. actinophora* that, as already stated, its discoverers regarded it as identical with the latter. But if the description of Hertwig and Lesser is correct (and this can hardly be doubted in the case of such accurate observers), there can be no further question of a union of the two species. Thus the envelope of *Cochliopodium* represents a true carapace, which "shows a hatching perpendicular to the surface," and thus acquires a great resemblance to the carapace of an *Arcella*. From its firmness it cannot be perforated by pseudopodia, and it has only a wide aperture "opposite the cell-nucleus" for the issue of protoplasmic processes, which gives it perfectly the appearance of a monothalamian when it is looked at from the side (Taf. ii. fig. vii. A). In this position *Cochliopodium* would then correspond to my figure 9. But, singularly enough, a state also occurs, and is very distinctly figured by Hertwig and Lesser in their fig. vii. C, which exactly represents an *Amœba actinophora* when the cortical layer has liquefied on all sides (fig. 12).

Hertwig and Lesser explain the matter by supposing that the perfect disappearance of the envelope is only delusive, owing to the animal here being seen not from the side, but

* *Loc. cit.* pl. ii. figs. 7, 8.

from above and behind, whilst the clear border is due to the sarcode which has flowed out of the aperture situated beneath.

In *Amœba actinophora* this is certainly not the case, as I think I have shown distinctly enough, and as will be understood without further discussion by examining my fig. 11, in which the cortex only shows a few remains (*r s*), which have already completely disappeared in fig. 12; or my fig. 16, which represents the same example as fig. 9, which, without change of place, underwent the alteration under my eyes. The resemblance of *A. actinophora* to *Cochliopodium* is still further heightened when we see that the cortex also appears finely punctate or lined, which struck me especially on the addition of osmic acid (fig. 17). The hyaline protoplasm also then appears finely punctate; and the impression is produced as if the finest granules effected the liquefaction of the cortex by the reception of more fluid constituents between them.

A great similarity to the *Amœba* here described is presented by the Rhizopod represented by Hertwig and Lesser as a doubtful form in fig. 8 A, as will be seen from a comparison with my fig. 10. In this, however, the envelope (which is even of a yellowish colour) is evidently much thicker.

We may therefore demonstrate a perfectionation of this structure from *Amœba tentaculata*, through *A. actinophora*, to *Cochliopodium*. It might be conceived that by a further increased tenacity of the cortical zone we shall finally be led to those forms of monothalamous Rhizopods whose envelope forms only a soft membrane closely embracing the sarcode, and which is still so completely at one with the protoplasmic body as to accompany it in all its movements, and to be constricted simultaneously in the division.

Glancing back once more upon the phenomena which confront us in the Amœbiform Rhizopods surrounded by a distinct cortical zone, we shall find in them a welcome elucidation of conditions such as have only been guessed at in the case of other *Amœbæ*.

In the sarcode-body more fluid and less fluid constituents are present; the former we find at the spots which betray a centrifugal movement, whether in the pseudopodia or in the advancing part of the flowing *Amœbæ* (*A. quadrilineata*, *villosa*, *tentaculata*, &c.). The heavier constituents remain behind and are dragged along; and we see them finally break into many cushion-like processes of hyaline protoplasm.

The pushing forward of the more fluid constituents is effected by the action of a pressure upon the opposite side; this is produced by the outermost layer of protoplasm at this part acquiring a tougher consistency by extraction of water.

The latter is widened, during the flow of the *Amœba*, at the posterior end, by all sorts of processes, lobes, hairs, &c., which often give the *Amœba* a peculiar aspect, and have led to the establishment of distinct species*. The sarcode here becomes so tough that as the *Amœba* hastens forward it draws into threads, if the expression may be allowed.

If the direction of movement is reversed, the previous posterior extremity begins to flow, and the most tenacious protoplasm occurs on the opposite side. These conditions may be equally well studied on the lobate pseudopodia, as also during the retraction of the pseudopodium, on the surface of which all sorts of humps and folds are produced.

A tougher cortical zone of this kind is actually to be seen in the forms here under consideration. When there is a centripetal pressure acting uniformly, it surrounds the whole *Amœba* like a membrane; if the pressure ceases on all sides the *Amœba* flattens into a disk, the cortical zone liquefies and flows together into a clear border of more fluid sarcode; but if the pressure acts on one side, the liquefaction takes place only on the opposite side, and the mode of movement which may be called the flow of the *Amœba* is produced.

In the formation of individual pseudopodia (see *A. tentaculata*) it is only a few spots that are subjected to these conditions, and in accordance with this the tougher cortex dissolves only at certain points, making way for the issuing softer sarcode.

EXPLANATION OF PLATE IX.

Figs. 1–8 relate to *Amœba tentaculata.*

Fig. 1. An *A. tentaculata* with many pseudopodia.

Fig. 2. Another, 0·12 millim. long, under a higher power (Hartnack eyepiece 3, objective 10 immersion) and drawn with the *camera lucida.* It shows the cortical zone (*r s*), the pseudopodia (*ps*) on their cones, and at *k* a cone of which the pseudopodium has been retracted (crater).

Fig. 3. A portion of an *Amœba* with three pseudopodia, highly magnified.

Fig. 4. A specimen on which a number of craters (*k*) are to be seen.

Fig. 5. A specimen in which the cortical zone is dissolved.

Fig. 6. A flowing *Amœba tentaculata,* in which the nucleus (*n*) is very distinctly visible.

Fig. 7. Another, in which three pseudopodia (*ps*) are still retained on the advancing part.

Fig. 8 A. A pseudopodium with its cone. *m*, the soft interior mass; *b*, the cortex; *p*, the pseudopodium.

Fig. 8 B. A pseudopodium in course of being retracted.

Figs. 9–17 relate to *Amœba actinophora.*

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* These structures have recently been referred to by Engelmann (Onderz. Physiol. Lab. Utrecht, Deel vi. Afl. 2, St. 4).

Fig. 9. An *A. actinophora* with a distinct cortical layer (*rs*), and a tuft of pseudopodia at one end (Hartnack, oc. 3, obj. 7).

Fig. 10. Another with few pseudopodia, distinctly showing how they break through the cortex. (Rather too large in proportion to the following figures.)

Fig. 11. The same example a short time afterwards. The cortex (*r s*) is almost everywhere liquefied, and has become converted into a clear space (*h*): *n*, the nucleus, which is distinctly visible in this state.

Fig. 12. The same, with the cortex completely dissolved. *v c*, contractile vacuoles.

Fig. 13. The same, in slow flow in the direction indicated by the arrow. *r s*, the newly reconstituted cortex.

Fig. 14. Another example, in which the cortex has just become liquefied, but is still retained at one spot, together with two pseudopodia.

Fig. 15. An *Amœba* in which the cortex has dissolved before two pseudopodia (*ps*) were retracted. These become liquefied soon afterwards. In this and

Fig. 16 the granular protoplasm is sharply separated from the hyaline zone. This, however, only lasts for a few moments, to give place to the state in fig. 12.

Fig. 17. An *Amœba* in which the liquefaction of the cortex had just commenced on one side, treated with osmic acid. The cortex (*r s*) appears finely punctate, as also the hyaline sarcode; the nucleus at *n*.

XV.—*Contributions towards a General History of the Marine Polyzoa.* By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Continued from vol. viii. p. 136.]

[Plate V.]

IX. FOREIGN CHEILOSTOMATA (Miscellaneous).

Family **Flustridæ.**

FLUSTRA, Linnæus.

Flustra dentigera, n. sp. (Pl. V. figs. 7, 7 *a*.)

Zoarium of a rather dark-brown colour and a somewhat waxy appearance, with a narrow smooth edging, dividing dichotomously into tall, linear, strap-like segments, expanding very slightly upwards, which are not divergent, but continue in close proximity throughout their length. *Zoœcia* alternate, elongate, arched above and somewhat expanded, usually narrowing slightly below the middle, a line of nume-

rous denticles along the inner edges; margins thin, smooth, very little raised. *Oœcia* immersed, of large size, tall, of delicate material, perfectly smooth and shining. *Avicularia* none.

Loc. West Australia (*Miss Jelly*).

In some respects allied to *F. denticulata*, Busk, and notably in being furnished with marginal denticles, but differing from it in many points. It is quite destitute of spines and avicularia; and the oœcium is immersed, whereas in *F. denticulata* it is external and bears the large avicularium on its front. In the mode of branching and general appearance the two species are also very dissimilar.

I have only seen small pieces of *F. dentigera*, and can therefore give no account of the size which it attains; its habit of growth is very distinctive.

This form is not described in any of the Australian papers which I have met with, and seems to be new.

Family **Membraniporidæ.**

Membranipora, De Blainville.

Membranipora pilosa, Linnæus, form *multispinata*. (Pl. V. fig. 6.)

Zoœcia claviform, ovate above, narrowing off gradually towards the base; area occupying about two thirds of the front, with a membranous covering; margin thin, smooth, bearing on each side eight to ten slender compressed spines set very closely together, which bend abruptly inward, meeting and interdigitating in the centre; a single erect, rather stout, acuminate spine on each side at the top; immediately below the area a similar spine rising from a socket on the front wall; portion of the cell below the area smooth and silvery, bearing near the bottom two large membranaceous spines, placed one on each side, which sometimes attain a great length. No *avicularia*. *Oœcia* (?). *Zoarium* expanding regularly from the point of origin to a width of about four cells, and bifurcating at intervals; sometimes forming a regular crust.

Loc. West Australia, on weed (*Miss Jelly*).

M. pilosa is liable to so much variation that I do not venture to separate the present form from it, though it has a very definite character of its own.

Its chief peculiarities are the great number of the marginal spines, which are compressed and set closely together, and very much bent in, so as to present the appearance of a ribbed covering to the area, and the absence of the disks which

give the prettily speckled appearance to the front wall of *M. pilosa*. The margin of the aperture is not thickened as in the latter; and the two very tall spines near the bottom of the cell are an additional feature.

Membranipora variegata, Hincks.

['Annals' for August 1881.]

The specimen on which my description of this well-marked and handsome species was founded proves to have been imperfect; and an important character has been omitted. In point of fact it belongs to the same group as our British *M. spinifera*, which is characterized by the presence of small, pointed avicularia, elevated on tall and slender pedicles. In the present case there is some irregularity in the position of these appendages; but when present they are commonly situated on one side of the cell, just behind the lowest of the two stout upper spines. The pedicle is much attenuated towards the base; the avicularium is narrow and elongate, and the beak scarcely bent at the extremity.

I am indebted to Miss Jelly for the opportunity of examining a number of specimens of *M. variegata*, and for drawing my attention to the very interesting fact that it is also sometimes furnished with avicularia of the ordinary type. This is the only case that has come under my notice in which the two forms are present on the same specimen. In one specimen, at the top of almost every cell there is a rather small, sessile or slightly raised avicularium, with the pointed mandible directed upwards. Occasionally three or four occur about the upper part of the cell.

In well-developed colonies of this species there is a marked contrast between the stout, tall, erect spines (usually six in number) round the upper part of the zoœcium, and the slender, sharp, abruptly bent spines which protect the lower half of it. They are all furnished with a conspicuous black base.

Membranipora coronata, Hincks.

['Annals' for February 1881.]

A specimen (probably from Ceylon) obtained by Capt. Cawne Warren is furnished with the chitinous portion of the avicularium, which was wanting in the one on which the original diagnosis was founded. I am now able to add that the appendage has a long vibraculoid mandible.

Family Microporidæ.

Steganoporella, Smitt.

Steganoporella (*Vincularia*) *Neozelanica*, Busk.
(Pl .V. figs. 9, 9 *a*, 9 *b*.)

I propose to test the method of classification which adopts the habit of growth as the chief basis of families and genera, by a reference to the history of this species.

It is (in one of its forms) an undoubted member of the genus *Vincularia*, Defrance; the zoœcia are arranged round an imaginary axis, so as to form erect, subcylindrical, continuous stems; the front of the cell is surrounded by a raised border (Busk, B. M. Cat. pt. 2, p. 96). The character of the stem—the mode in which the zoœcia are aggregated—is the essential feature of the Vincularian family.

V. Neozelanica occurs in two or three different forms. Miss Jelly has kindly supplied me with a specimen which spreads in a single layer over the surface of a sponge and is simply incrusting. There is no special modification of structure adapting it to its peculiar habitat, such as we find in *Membranipora radicifera*; but on one of the few cells of which the dorsal surface is exposed there is a large, stout, spinous process, which is possibly an effort towards the development of some additional means of attachment.

In the erect cylindrical form the stems are attached by means of a number of chitinous tubular fibres, which are given off from the surface of the lower cells (Pl. V. fig. 9 *b*).

Amongst the specimens which I owe to Miss Jelly are one or two small fragments of a broader and more compressed type, which approach more nearly to the ordinary Escharine habit. If we examine the zoœcium, we find that its structure agrees in every essential point with that which we have in *Steganoporella* (*Membranipora*) *magnilabris*, Busk. There is, indeed, the closest similarity between the two (compare Pl. V. figs. 8 & 9). It would be impossible, with any regard to natural affinity, to place these forms in separate genera*. But *S. magnilabris* is prevailingly an incrusting form; occasionally it assumes an erect, broadly foliaceous habit of growth. No cylindrical variety of it is known.

Another species which exhibits the same remarkable structural peculiarities as the two just referred to is *Steganoporella Smittii*, Hincks (Hist. of Brit. Mar. Pol. vol. i. p. 178). According to Mr. Goldstein, this species, which is known as

* Smitt has already made a similar remark ('Floridan Bryozoa,' pt. 2, p. 17).

an incrusting form, both fossil and recent, assumes the habit of *Vincularia* on the coast of Australia. It also occurs, according to this writer, (at Port Darwin) in an Escharine and Hemescharine form, as well as incrusting*. We have, then, the same type of cell, and *that a very remarkable and characteristic one*, associated with the Vincularian habit (*S. Neozelanica*); with the crustaceous and Escharine habit (*S. magnilabris*); and with the Hemescharine habit (*S. Smittii*). And, further, we have this type of cell combined with *all* these modes of growth (according to Goldstein) within the limits of a single species (*S. Smittii*).

The significance of these facts will be more fully appreciated if we consider the remarkable structural features of the cell which is common to *V. Neozelanica*, Busk, and *Membranipora magnilabris*, Busk. The chief character on which the genus *Steganoporella*, mihi (which embraces them both), is based, is the bithalamic condition of the zoœcium. Some way below the upper extremity of the cell a diaphragm shuts off the lower portion of the cavity, and forms a distinct chamber for the polypide. A tubular passage (Pl. V. fig. 8 *a*) extends upwards from this chamber, and opens (in the two species before us) into the upper chamber, which is always large, and, in certain cells, of very ample dimensions; in the latter it probably represents the external oœcium of other forms. The opening of this chamber is closed by a very large operculum, which also protects the entrance to the tubular passage through which the polypide issues. In the calcareous lamina covering the area there are two foramina, one on each side, which open into the upper chamber. In the two forms under consideration a screen-like denticle, deeply concave in front, rises from the edge of the tubular passage, and occupies the middle of the lower margin of the orifice. In the perfect state an opaque membrane extends from the base of the operculum to the bottom of the cell, a space intervening between it and the calcareous lamina. A glance at the figures (Pl. V. figs. 8, 8 *a*, and 9, 9 *a*) will show the exact similarity between the two forms in all essential points; they are also curiously alike in some of the minute details. It is impos-

* "Some new species of Bryozoa from the Marion Islands, with Notes on *Bicellaria grandis*," by J. R. Y. Goldstein. I have only a separate copy of this paper (for which I am indebted to Mr. Goldstein's courtesy), and am unable to give a more specific reference. The author considers the changes of habit in *S. Smittii* to be "a sort of mimetism," and he proposes to show "the importance of true zoarial habit as distinct from mimetic changes of form." I am not sure that I rightly apprehend the writer's meaning in this passage, and must be content to wait for a fuller statement of his views.

sible to doubt their close relationship; in no natural system could they be kept apart. Yet the one exhibits the technical characters of *Vincularia*, and the other a mode of growth which is generically distinct, according to the older systematists. If the method of the latter is adopted, they must go into different *families*.

This case is a crucial one; for the strongly-marked individuality of the zoœcium leaves no doubt as to the close affinity of the two species, while, at the same time, the difference in zoarial habit is unusually striking.

We are led to the same result by a study of the various forms which exhibit the Vincularian mode of growth. So far as the zoœcium is concerned they constitute a very heterogeneous assemblage. Some have the Membraniporan cell, such as *V. ornata*, Busk, and a number of species described by Waters in his valuable paper on Australian Tertiary Polyzoa*; *V. abyssicola*, Smitt, has the cell of *Setosella*, and ranks in the Microporidan family; *V. steganoporoides*, Goldstein, seems to belong to the same family. *V. Neozelanica*, Busk, is a typical *Steganoporella*, one of the best-marked of the Cheilostomatous genera; while *S. Smittii*, Hincks, is by turns a Vincularian, Escharine, or crustaceous species!

The conclusion to which we are almost irresistibly conducted is that the mere fashion of zoarial growth is not a safe test of affinity, that it is a very variable and comparatively unimportant element in the life of the species, and that, in such forms as we are now considering at least, it can give us little help in the construction of a natural system.

The Vincularian is one of the most strongly marked varieties of habit; yet, as we have seen, we find two forms the cells of which show that they are very slightly modified derivatives from a common ancestor, one of which is Vincularian and the other crustaceous or Escharine. We are brought very much to Prof. Smitt's conclusion, "that neither the agreement nor the diversity in the mode of building their colonies will give any warrant as to the natural affinities of the higher Bryozoa" ('Floridan Bryozoa,' pt. 2, p. 7).

The Vincularian habit then, like the Escharine, I regard as a condition that may be assumed (within certain limits) by the most diverse species; and the forms which exhibit it, either constantly or occasionally, must be placed in the groups to which their general structural peculiarities ally them. The genus *Vincularia* has no *raison d'être*.

Mr. Goldstein, in the paper referred to, urges that, as con-

* Quart. Journ. Geol. Soc., August 1881.

fessedly our present knowledge does not allow of a complete natural arrangement, it may be wiser to rest on the old lines and retain for the present the artificial system so long in use.

From this view I must entirely and earnestly dissent. I hold that it is all but demonstrated that zoœcial, and not zoarial, characters must be the basis of a *natural* classification of the higher Polyzoa. And if this be so, it is surely in every way better to apply this principle as far and as well as our present knowledge will permit, *and allow it to give the direction to further investigation*, than to perpetuate a system which, however convenient to the collector in the arrangement of his cabinet, gives him no help towards understanding the order of nature. Let us set our faces in the right direction, and while admitting freely the extent of our ignorance, make full use of the knowledge which we have.

The Radical Tubes.—The erect stems of *Steganoporella Neozelanica* are attached by tubular fibres; and in this respect it differs from its congeners. The difference, however, can hardly be accounted important. The fibres are a tubular extension of the membrane which covers the front of the cell, and seem only to originate from the zoœcia close to the base of the stem. In the (so-called) *Flustra solida*, Stimpson, the curious fibres which traverse the surface of the zoarium, uniting to form a kind of stem below, from which the radical fibrils are given off, originate in the same way from an epidermal covering of the cells. In the Microporidan *Vincularia abyssicola* * Smitt figures the cylindrical stem as continuous with the incrusting layer of cells from which it rises, and of course destitute of root-fibres. The stems of the present species probably rise in the same way from an incrusting layer; and if so, the tubes may be developed at a later stage, in preparation for the ultimate detachment of the stem from the adherent mass of cells.

Oœcium.—The very large size of the upper chamber in this form and the kindred *S. magnilabris*, in a certain number of the cells, suggests at once that it is the equivalent of the oœcium. If so, the modification is a very interesting one. The dithalamic condition is made subservient to the reproductive function; in certain of the cells the upper compartment is largely increased in size, and in this specialized form is no

* In a note on *V. abyssicola* ('Annals,' February 1881) I have stated that this species and *V. ornata*, Busk, are true "Membranoporidæ." This is an error. The latter is a *Membranipora*, the former a *Steganoporella*, and belongs to the Microporidæ.

In the same note the *second* sentence should read thus:—"I mention this to show how essentially Microporidan [not *Membraniporidan*, as printed] the zoœcial character of this form is."

doubt utilized as a brood-chamber. In other members of the genus the oœcium is external; in the cells on which it occurs (in *S. Rozieri*, Audouin) the zoœcial orifice is much larger than in those which are destitute of it, but does not equal in size that of *S. magnilabris*. Above it an ample bilobate structure is developed, forming, as it were, a dome over the internal chamber, with the usual arched opening in front, which is closed by the large operculum. In the ordinary Cheilostomatous forms the inner chamber has no existence, and the oœcium is a mere hood-like receptacle which overarches the orifice, on the upper margin of which, or immediately behind it, it takes its origin. In a previous paper ('Annals,' August 1881) I have described a modification of the oœcium, which consists of an extension of the cell itself, roofed in by a number of marginal spines; and there are many other forms which have still to be investigated. The morphological history of the oœcium has yet to be written.

The following species belong to the genus *Steganoporella*:—*S. Rozieri*, Audouin: Rio de Janeiro (*Darwin*); Mazatlan (*Dr. P. P. Carpenter*); California (*T. H.*); Zanzibar (*W. Oates*); India (*Miss Jelly*); Australia (*MacGillivray*); form *falcifera*, ibid. (*Miss Jelly*). *S. Smittii*, Hincks (=*Memb. Andegavensis*, Busk): Cornwall (*Peach*); North Australia (*Goldstein*); Coralline Crag (*Searles Wood*). *S. Neozelanica*, Busk: New Zealand (*Dr. Lyall*). *S. magnilabris*, Busk (= *S. elegans*, Smitt): Abrolhos Islet, Atlantic (*Darwin*); Algoa Bay (*Bowerbank*); Singapore (*T. H.*); Bass's Straits (*Cawne Warren*). *S.* (*Membranipora*) *perforata*, MacGillivray (probably a form of *S. Rozieri*), Victoria; and perhaps *Vincularia Novæ Hollandiæ*, Haswell: Queensland.

The species which I have described ('Annals,' Nov. 1880) under the names of *S. Jervoisii* and *S. elongata* are referable to the genus *Micropora*, as is also the *Vincularia steganoporoides* of Goldstein.

Family **Monoporellidæ.**

Monoporella, Hincks.

Monoporella albicans, n. sp. (Pl. V. figs. 5, 5 *a*, 5 *b*.)

Zoœcia ovate, very irregularly arranged, convex, surface minutely granular, shining; orifice arched above, lower margin straight or very slightly curved outward, peristome not raised; just below the orifice a rostrum, with an *avicularium* on one side, mandible short, rounded; large *avicularia* distributed amongst the cells, elongate, the beak at the extremity

rising into a hood-like expansion (Pl. V. fig. 5 *b*); mandible long, broad at the base, narrowing off to about the centre and then of equal width to the extremity, which is rounded. *Oœcium* rounded, suberect, with a large opening in front, broader than high, surface minutely roughened, frequently an umbo on the top (Pl. V. fig. 5 *a*). *Zoarium* of a whitish shining material.

Loc. Singapore or Philippines (*Miss Jelly*).

Provisionally, at least, it will be better to keep the genus *Monoporella* apart from the *Microporellidæ*. If (as seems probable) the special pore of the latter is represented by the oral sinus of the Myriozoidæ, *Microporella* will have closer affinity with such forms as *Schizoporella* than with the present. As yet the species of *Monoporella* described are but few, and we have hardly material for a thorough study of the type.

There is a curious similarity in many points between this species and *Schizoporella aperta*, described in a subsequent part of this paper; and probably they may be not remotely connected genetically. But they are separated, in fact, by well-mare d differences in the structure of the orifice, and for the purposes of classification are properly placed apart. At the same time we cannot be too often reminded that the hard-and-fast lines of our systems have no place in nature.

In the specimen of *M. albicans* which I have examined the oœcia, which are numerous, are placed in almost all cases (if not all) awry, so that the opening is turned sideways, instead of looking straight forward as is usual. This is probably a peculiarity of the special colony and not a general character.

Family **Myriozoidæ** (part.), Smitt.

Schizoporella, Hincks.

Schizoporella incrassata, n. sp. (Pl. V. figs. 1, 1 *a*.)

Zoœcia ovate, quincuncial, punctured round the border, the marginal cells moderately convex, with a perfectly smooth surface, the older highly calcified, the walls very thick, vitreous, shining; surface covered with irregular nodulous masses; orifice suborbicular, with a well-marked rather narrow sinus on the lower lip, peristome in the younger cells thin and not elevated, in the adult zoœcia the orifice deeply immersed, the cell-wall much raised and thickened round it, forming a kind of shaft above it; at one side below the mouth a large rounded swelling, bearing on its upper surface a suberect pointed *avicularium*, placed transversely along one

side of the lower margin, and somewhat overhanging the mouth (the whole structure resembling a bird's head); mandible broad below, tapering off to a point above, apex incurved; frequently on the front of the cell a pointed *avicularium*, variously placed, the beak elongate, slanting upwards, aperture contracted about the middle, mandible triangular, basal portion of the avicularium extended into a pointed process, which forms a rest for the mandible when thrown back. *Oœcia* suberect, rounded, subimmersed; surface smooth (or sometimes nodulous), with a semicircular aperture in front, filled in by a thin, flat, calcareous plate, hyaline and perfectly smooth.

Loc. Africa, on coral (*Miss Jelly*).

This species affords a good illustration of the remarkable changes in the appearance of the zoœcium which may be caused by the progress of the calcification. In its early condition (as seen on the margin of the colony) the cell has a slightly convex and perfectly smooth surface of very delicate texture. The orifice is a simple opening, on a level with the surface, and without any thickening or elevation of the margin. At this stage there is no trace of the oral avicularium. In the second line of cells this organ is more or less perfectly developed; the orifice is already immersed and concealed by the rising of the peristome and the thickening of the wall, and the surface is dotted over with small vitreous nodules. In the centre of the colony a great thickness of vitreous crust is piled on the primitive surface of the cell, the orifice has disappeared at the bottom of a deep shaft-like opening of irregular form, and numerous nodular blocks overspread the surface, which are frequently consolidated into a compact mass, in which the avicularian rising is almost buried. The sutures between the cells are now all but obliterated, and the zoarium presents a continuous but uneven surface. The front avicularia are developed on the superimposed crust.

Schizoporella levata, n. sp. (Pl. V. fig. 4.)

Zoœcia small, disposed in lines, regularly ovate, convex, strongly sutured; surface perfectly smooth and shining; orifice arched above, lower margin straight, with a minute but well-marked central sinus, peristome not raised; below the orifice an umbonate rising, which sends off an arm on each side, so as to enclose it in front; on its summit a minute circular *avicularium*. *Oœcium* proportionally large, rounded, expanded above, and narrowing towards the orifice, very ventricose above, and somewhat depressed towards the open-

ing, which is small and bounded by a raised projecting margin, which embraces the orifice on each side; surface smooth and silvery, with very delicate striæ radiating from the base towards the opening.

A very pretty, subhyaline, and lustrous form.

Loc. Australia, on weed (*Miss Jelly*).

Schizoporella aperta, n. sp. (Pl. V. fig. 3.)

Zoœcia ovate, disposed in lines, very convex, especially towards the orifice, depressed below, sutures deep; surface roughened or minutely reticulate; orifice arched above, lower margin straight, with a rounded central sinus, contracted at the opening by two small projecting points, peristome not raised; immediately below the orifice a short rostrum, and on one side of it an *avicularium* with rounded mandible; large *avicularia* distributed rarely amongst the cells, elongate, raised, the beak rounded at the extremity, often projecting considerably beyond the elevation on which the appendage rests, the edge on each side towards the apex dentate; mandible smooth, of a light horn-colour, arched, except towards the point of origin, where it is flattened, very slightly attenuated towards the point, which is rounded. *Oœcium* cucullate, entirely open in front, the opening arched and somewhat elongated (taller than broad); surface slightly roughened. *Zoarium* whitish, of delicate texture.

Loc. Singapore or Philippines, on shell (*Miss Jelly*).

Family **Escharidæ** (part.), Smitt.

PORELLA, Gray.

Porella rostrata, Hincks. (Pl. V. fig. 2.)

I have received from Miss Gatty a fine specimen of this form, on which the oœcia are present; the following must be added to the diagnosis previously given ('Annals' for Nov. 1880):—

Oœcium very ample, covering a large part of the cell above, broad, rounded; surface smooth and shining, thickly covered with tall blunt papillæ.

It should also be noted that the surface of the zoœcium is more or less punctured.

EXPLANATION OF PLATE V.

Fig. 1. *Schizoporella incrassata*, n. sp. 1 *a*. Marginal zoœcia.
Fig. 2. *Porella rostrata*, Hincks. Oœcium.
Fig. 3. *Schizoporella aperta*, n. sp.
Fig. 4. *Schizoporella levata*, n. sp.
Fig. 5. *Monoporella albicans*, n. sp. 5 *a*. Cell with oœcium. 5 *b*. Large avicularium.
Fig. 6. *Membranipora pilosa*, form *multispinata*.
Fig. 7. *Flustra dentigera*, n. sp. 7 *a*. Nat. size.
Fig. 8. *Steganoporella magnilabris*, Busk, with the membranous covering *in situ*. 8 *a*. Diagrammatic figure, showing the tubular entrance to the lower chamber *.
Fig. 9. *Steganoporella Neozelanica*, Busk (Vincularian form), with its membranous covering. 9 *a*. Showing the structure of the cell. 9 *b*. Nat. size (two forms).

XVI.—*Description of a new Species of the Homopterous Genus* Aphæna *from Sumatra.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

The species which I here describe was obtained last year by purchase, and it struck me at once as a very beautiful and new Homopteron allied to *Aphæna submaculata*; but upon showing it to my friend Mr. W. L. Distant, I found that he was inclined to regard it as a very fine and highly coloured variety of that species, though without careful comparison of the structural details of the two insects he was not prepared to declare absolutely that they were not distinct. This, after a minute examination of our specimens, I am fully convinced to be the case, and therefore I do not hesitate to describe the species.

Aphæna chionæma, sp. n.

General form of *A. submaculata*, but the tegmina relatively broader across the middle, owing to the greater arch of the costal margin †; the outer margin is also very decidedly longer, forming an oblique straight edge instead of an arch continuous with that of the apical portion; the apex, therefore, is more prominent than in *A. submaculata*. The thorax,

* Actually the orifice of the tubular passage is placed far down within the upper chamber, and is not easily seen.

† This I have proved by careful measurement, the difference in width between the middle and the widest part in these wings being exactly 2 millim. both in the larger and the smaller insect; to an artistic eye the different outline is most marked.

though naturally larger altogether, is comparatively slightly shorter; and the spinose dorsal processes in the centre of the hind margins of the meso- and metanotum are distinctly more prominent; the posterior edge of the pronotum is more distinctly carinate, and the surface much more irregular; the front margin of the head is comparatively much narrower, making the head altogether less quadrate in form; the reflexed frontal horn is considerably longer, being carried backwards the whole length of the head over the pronotum, whereas in *A. submaculata* it is of only two thirds this length; the upper surface of the horn is narrower throughout, and therefore more sharply sulcated down the centre; the frons is almost identical in form and sculpture; spines on the posterior tibiæ less acute.

Tegmina above blood-red, mottled all over with snow-white spots, most of which are confluent beyond the middle; the costal and external borders regularly spotted, the former with white and the latter with slaty-black spots: wings intense black, sparsely spotted with white, but the spots much smaller than in *A. submaculata*; the apical border washed with chestnut-red; veins at base scarlet; the abdominal and anal borders whity brown, interrupted by the white spots: head and pronotum scarlet, the latter with black lateral anterior margins and a black spot on each side; mesonotum black, with a large irregular central scarlet patch; metanotum black, outlined in scarlet; abdomen cadmium-yellow, almost entirely covered by the ordinary white waxy secretion common to the group; tegmina below brilliant carmine-red, the basal two thirds streaked transversely with grey; a few white-centred glaucous-grey rounded spots scattered irregularly over the external third; costal border crossed by black spots and dashes; external border with a marginal series of small black spots. Wings below much as above, but the nervures beyond the middle relieved in greyish white, and the white spots congregated on the apical instead of the abdominal half, the borders also greyish, veins at base scarlet, as above: body below scarlet, margins of metasternum stramineous; middle and posterior coxæ clouded with black. Exp. tegm. 89 millim.; corp. long. 26; noti lat. 9; long. cum capite 12½; abdom. long. 13½.

Sumatra (*Ch. Curtis*). Type B.M.

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The Zoological Record for 1880 (vol. xvii.).
Edited by E. C. Rye. London: 1881.

Zoologischer Jahresbericht für 1880.
Redigirt von Prof. J. Vict. Carus. Leipzig: 1881.

It is with very great satisfaction that we are able to report that the two zoological records (proper) for the year 1880 appeared before the end of the year 1881. We shall not here take any notice of the reports which appear as part of the 'Archiv für Naturgeschichte;" for they have acquired an antiquarian right to appear whensoever they please. Rivalry has shown itself to be so far advantageous that the early appearance of what we will call the Naples 'Record' for 1879 has given a new, and a needed, impetus to the more speedy publication of the volume which appears under the auspices of the Zoological Record Association.

When we look in a broad way at what is to be expected from an effort of this kind, the first question we have to ask ourselves is as to the scope of such a work; from a theoretical point of view, we expect anatomical, embryological, and palæontological studies to be no less recognized than the work of the descriptive and systematic zoologist. When we examine it from a practical point of view we find that, in addition to these requirements, we have to demand compendiousness, facility of reference, and peculiar attention to such points as might easily escape a worker in a narrow groove. It is not so necessary to refer in detail to Prof. Huxley's work on the gills of crayfish as to an obscure notice of rare species in a journal with a limited circulation: no student of carcinology can fail to hear of the one; but it is far from all that will, from more general sources, become acquainted with the existence of a paper by Mr. Haswell on some new Amphipods from Australia and Tasmania. Compendiousness is hardly to be associated with a detailed statement of every fossil fish or coral; and that work is more particularly undertaken by the 'Geological Record.' Thus, then, we find that the English 'Record,' of which the 17th volume has now appeared, and which has been under the care of such practised and practical workers as Dr. Günther, Prof. Newton, and Mr. Rye, has dealt with anatomical and palæontological study in much less detail than with the ever-growing and overpowering force of the descriptions of new forms. On the other hand, the Naples 'Record' takes all zoology for its province. As it has thus put itself into rivalry with a publication which had learnt its true position, and had been, in some departments, served for many years by the same experienced hands, let us see how it has justified its boldness. Last year we refrained from criticism from the *reverentia quæ debetur pueris*; but

we fear that the kind of work which received last July somewhat severe treatment from our contemporary, the 'Ibis,' is not a little repeated in the volumes now before us.

We have, however, a somewhat difficult task; we demand facility of reference, and the work gives us indices which look most complete; even, however, with their aid we cannot find any indication of a report of Prof. Huxley's paper on the Evolution of the Vertebrata. We cannot believe that it is omitted; but perhaps it does not contain sufficient names for undiscovered and hypothetical groups to bring it within our foreign friends' idea of what should constitute a zoological essay.

Let us then take rather some representative group of working zoologists; perhaps we can not do better than select for this purpose the eleven who prepared the English 'Record' for the year 1879. They will be found to fall into two groups, one of which is well, the other insufficiently reported. Mr. Forbes will have some trouble to find his third paper on the "Anatomy of Passerine Birds;" for it is not in the index; the title is not given in the chapter on Birds, but it is placed among the general papers on the anatomy of Vertebrates. So, again, his paper on the Ploceine birds is not in the index; and we leave our ornithological readers to imagine his feelings when he finds *Pytelia* (*wieneri*) appear as *Pitylia*; *Pytilia* has, we know, been used by Dr. Cabanis; but Mr. Forbes deals with that point in a footnote to his paper. Mr. Kirby's parting gift to Dublin (his account of the new species of Lepidoptera in the collection of the Museum of the Royal Dublin Society), Mr. Bell's paper on *Pentastomum*, which appeared in the pages of this journal, Mr. Ridley's essay on foreign sponge-spicules, which was thought worthy of publication by a society which is in the habit of taking the opinion of experts on the value of the papers submitted to it, seem all to have been neglected. It is hard on the poor parasitic Arachnids that the only paper written about them during the year 1880 should be forgotten; it is not right that a maiden paper on sponges should be neglected. Did the student of the Arachnida look for O. P. Cambridge or for *Argyrodes* in either Autoren- or Sachregister he would find that the important paper which is noted in the body has not found its way into the necessary appendages. Dr. von Martens would appear to have been well treated; and that Mr. M'Lachlan comes off well, *cela va sans dire*, when we add that he falls to the recordership of so experienced and so admirable a worker as Dr. Hagen. Mr. Saunders and Mr. O'Shaughnessy, with two papers each, are duly recorded, as are Mr. Hickson and Mr. Bourne with one each; and Mr. Bourne, indeed, gets as much as what would amount to one tenth of his own paper, and to about four times as much as his own excellent summary.

But what shall we say of the treatment given to works on systematic zoology, so important as those which form part of the Catalogue of the British Museum? Last year Mr. Sharpe was very incompletely reported; this year we are calmly told that Lord Walsingham's quarto volume on Lepidoptera has not been seen by the

Recorder. If Recorders undertake work when they live at inaccessible distances from the libraries of great cities, they must suffer for their zeal and buy the books; if they plead that British-Museum catalogues are very expensive, we can only answer that the just-mentioned naturalist's account of the Pterophoridæ of California, which might have been bought for a few shillings, is not even mentioned by name: nor would Dr. Jentink have been ruined by the price of the second edition of Mr. Pascoe's 'Zoological Classification,' which he notes as not having been seen.

There are some striking errors in judgment: we must own that we do not think we could have recorded Mr. B. Clarke's ideas on zoological classification once (it is here done twice) without a very serious disturbance of our risible faculties; we should have doubted the value of teaching zoologists how to clean cover-glasses; and although we know that a correspondent of 'Science Gossip' performs admirably well his duties as a waiter at a hotel in Canterbury, we should not have handed to posterity his account of his inspection of a Rotifer. We should have refrained from taking advantage of our position to name an unnamed species (pt. i. p. 289): and we should not have done more than give the titles of the papers in which Professors Agassiz and Bell amused the Zoological Society with their different accounts of what the elder Agassiz meant.

One or two other criticisms remain to be made; if the chapter on sponges is to be taken as a type of the whole, misprints abound; *e.g. Chalina fostilis* for *C. fertilis* (p. 174); Monoxidæ for Monaxidæ (p. 176); the charming generic term *Protoschmidtia* has a *t* between the *P* and *r*; *Cladoriza*, which, by the way, is a genus of Sars's (1872), and not a new genus, is spelt *Chladoriza*; and on the same page (p. 183) we have *vilifica* for *silifica*. Some of Vosmaer's new species of *Clathria* are given, but *C. elegans* is omitted. Among the Bryozoa we find no note of Mr. Haswell's new species, *Myriozoum australiense*.

To sum the matter up, we will make two comparisons between a part of the Naples 'Record' that appears to us to be, from their point of view, particularly well done, and the same part in the English Record. Prof. Ludwig and Prof. Bell both appear to devote the greater part of their energies to the Echinodermata: and both omit one, though a different, paper of considerable importance. We cannot understand how one who has to do with collections which come from all parts of the world to the British Museum could have neglected to make himself acquainted with the important work of Möbius on the fauna of Mauritius; and Ludwig's omission of De Loriol's valuable monograph on Egyptian fossil Echinids is a matter for regret. Mr. Bell notices it, and, we observe, does not fail to indicate that the veteran echinologist is not satisfied with his new genus. But, as to brevity (no inconsiderable virtue), compare the two. The Englishman writes, "*Asterias palæocrystallus*, Sladen, is a *Pedicellaster*; Ann. N. H. (5) v. pp. 216, 217." The Naples Recorder gives seven lines to the same point. Lengthiness sometimes leads to confusion; no one who looks at the German account

of Mr. Dobson's new worm would imagine that the generic term *Pterygodermatites* was due to Wedl; but with the several lines there given the student is not reminded, as he is in the English work, that *Rictularia* is an older generic term.

The references are often incomplete; compare that of Günther's 'Introduction to the Study of Fishes,' an account of which is, *horrescimus referentes*, given in a third language (Italian), Örley's Monograph of the Anguillulidæ, or Balfour and Sedgwick's memoir on the Head-kidney of the Embryo Chick (pt. iv. p. 186).

A reference to the last paper, which is omitted seemingly from the English 'Record,' reminds us that Mr. Rye's coadjutors fail somewhat in their appreciation of anatomical works; "les ganglions sont confondus" is not to be translated by the "ganglia are confounded" (Ins. p. 2). Neither Mr. Kirby nor Mr. Ridley refer to their illustrious countryman's epoch-making work on comparative embryology; medical helminthology might, we should think, be more fully treated; the researches of Scott and Balfour on the lowlier Pisces might have had a word of explanation; a few words on the freshwater Medusa would not have been unacceptable; and something of general importance could surely have been found in Prof. Martin Duncan's fine work on Sind corals.

On the whole, however, we would recommend the working zoologist to put his trust in the English 'Record;' and we shall perhaps be pardoned if we suggest to the Naples staff that, having done the chief work for which they were called into existence, that of awakening the Englishman to a sense of the necessity of early appearance, they will reconsider the advisability of producing a work hasty and imperfect in execution, cumbrous for employment, uncertain in its accuracy, and ill-proportioned in its design.

Proceedings of the Bristol Naturalists' Society. New series, vol. iii. part ii. (1880). 8vo. Pp. 83–174. Also, new series, vol. ii. (1877–8–9). *Flora [recent] of the Bristol Coal-field.* Edited by J. W. White. Part I. Thalamifloræ. 8vo, 40 pages. Bristol, 1881.

As usual, this publication of the Bristol Naturalists is full of good matter. Dr. S. P. Thompson gives a concise and suggestive treatise on hearing with two ears, and describes also a new phonautograph. The breathing of aquatic larvæ, the local Lepidoptera, and the Fungi are special subjects; also the boulders of the Bromsgrove district. Notes on recent investigations on the course of storms, by Dr. Burden; on the preparation of a local Flora, by J. W. White; Mr. C. Jeck's optimist view of "Darwinism"; and Mr. Leipner's "Naturalist's Ramble in Guernsey," are all worthy of attention.

The first instalment of a new local flora, made by the personal exertions of the Society, and edited by the "Honorary Secretary of

the Botanical Section," is issued with this part. It contains the Thalamiflorals. Other portions will follow year by year. The next will give the Calyciflorals; the third, the Corollifloral; the fourth, Apetalous Plants; and the fifth and last, the Endogens, Gymnosperms, and Vascular Cryptogams.

Proceedings and Transactions of the Nova-Scotian Institute of Natural Science of Halifax, Nova Scotia. Vol. v. part iii. for 1880–81. 8vo. Pp. 223–315. Halifax, N.S., 1881.

Continuations of geological research in Nova Scotia, by the Rev. Dr. D. Honeyman, Professor of Geology in Dalhousie College, and detailed descriptions of lievrite and of the trap-minerals of Nova Scotia, by Edwin Gilpin, Government Inspector of Mines, and some Geological Notes by A. Cameron and Alfred Hare, constitute a goodly portion of this part. In Botany, Dr. Somers treats of the Fungi and Mosses of the country; and Mr. A. W. Mackay enumerates the Lichens. The birds of prey have an interesting memoir by Dr. J. B. Gilpin, an acute observer. He states that the Rev. Mr. Wainwright, a missionary in Labrador, with good eye and hand, shot an eagle rising eight feet from the ground with a fisherman's child in its claws, and dropped it so cleverly as not to hurt its living prey. Dr. Gilpin also gives a lively account of the dwellings of the Muskrat and Beaver of Nova Scotia. The ice-storm of January 1881 is noted by H. S. Poole, F.G.S., and Mr. R. Morrow, among the miscellaneous materials of this useful and interesting number of the Nova-Scotian Institute's Proceedings.

MISCELLANEOUS.

On the Origin of the Spermatozoids in the Hydroids. By M. A. de Varenne.

In a preceding note I had the honour of presenting to the Academy a summary of my researches upon the origin of the ovum in the Hydroids *; and I now wish to communicate the results to which my observations on the origin of the male sexual products in the same group have led me.

In the species that I have observed the mother cells of the spermatozoids appear not in the gonophores, medusoid buds, or Medusæ, as has hitherto been supposed, but in the tissues of the colony itself, in what Allman calls the *cœnosarc*. Weismann has lately described the same phenomenon in the genus *Plumularia*; but he thinks that it occurs with the spermatic cells only in this genus. I regret that I cannot adopt his opinion.

* See 'Annals,' October 1881, vol. viii. p. 321.

The three species that I have studied are *Campanularia flexuosa*, *Gonothyræa Loveni*, and *Podocoryne carnea*. I selected these three species for the purpose of following a course parallel to that which I pursued in regard to the development of the ovum. The first has its sexual generation represented by gonophores, which remain constantly attached to the hydroid polype; the second presents a semi-medusa, and the third a free medusa.

I find it impossible to share the opinion of those authors who accept the ectodermic origin of the male sexual products in these species.

In *Campanularia flexuosa* we find in the endoderm of the stem before the appearance of any gonophores, some large highly-refringent cells; these are the *primitive mother-cells*. They are round, and possess large nuclei with a nucleolus. The presence of a certain number of mother cells induces the formation of a gonophore, which is at first only a simple cæcal diverticulum of the endoderm and ectoderm. The endoderm of this diverticulum is thus occupied by a certain number of mother cells; and at this moment we can ascertain that the intermediate lamella certainly passes *over* these differentiated cells, and that consequently the origin of the testis is certainly endodermic.

It is very important, for the recognition of these facts, to observe the gonophores as young as possible, when the large mother cells, which are known by their refringency, occupy the endodermic wall of the body of the polype and are in immediate contact with the digestive cavity of the colony, and when the cæcal diverticulum above mentioned begins to make its appearance. In fact, after this moment the primitive mother cells multiply rapidly, and the daughter cells, which are much smaller and always possess refringent nuclei, form a testicular mass of a horseshoe form, which very rapidly increases in size. At the same time the testicular mass ceases to form part of the endodermic wall, and to be in direct contact with the digestive cavity of the colony; for the non-differentiated endoderm, previously interrupted at this point by the testicular mass, becomes reconstituted beneath this mass, and there forms a continuous layer. Thus, in consequence of this multiplication of the mother cells and the reconstruction of an uninterrupted endodermic layer beneath the testicular mass, it is very difficult at this moment to recognize the origin of the testis, which has become an isolated mass, between the ectoderm and the endoderm reconstructed beneath it; and in consequence of there being this endoderm of new formation, which may be mistaken for the primitive endoderm, beneath the testicular mass, one may very easily suppose that the intermediate lamella passes beneath the mother cells, and that therefore the origin of the spermatozoids is ectodermic. It is this, I believe, that has led into error the authors who accept the ectodermic origin of the male sexual products.

In *Gonothyræa Loveni* the affair takes place in the same manner, and I need not dwell upon it further.

In *Podocoryne carnea*, in the region of the body of the hydroid

polype where the medusæ are to bud forth, we find the endodermic wall occupied by large refringent cells; these are the primitive mother cells. Soon the endoderm and the ectoderm form a cæcal diverticulum, into which the mother cells pass. This diverticulum will become a medusa; and the mother cells will occupy its endoderm; the intermediate lamella passes over them.

I will not enter into the details of the development of the medusa, as I shall soon have the honour of laying before the Academy a memoir upon this subject. It will suffice to say that after this period the testicular mass grows rapidly, that the endoderm is reconstituted in the form of a new uninterrupted layer beneath this testicular mass, and that the mass of spermatozoids finally occupies the manubrium of the medusa between the ectoderm, which has become considerably thinner, and the newly-formed layer of endoderm already mentioned.

To sum up, in these three species

1. The male sexual products do not originate in the gonophores, medusoid buds, or medusæ, as has been supposed, but in the *cœnosarc* of the hydroid polype itself, as I have already shown to be the case with the ovum.

2. The primitive mother cells of the spermatozoids are derived, like the ova, from differentiated endodermic cells.

3. Like the ova again, these mother cells pass into a diverticulum of the walls of the body; and this diverticulum by development becomes a gonophore, destined to be always attached to the hydroid polype, or a semimedusa, or a free medusa.

4. The origin of the sexual products and their development therefore present a very great analogy in the male and female colonies.

5. If we accept these facts as demonstrated, the gonophores, the semimedusæ, and the medusæ in both the male and female colonies can be regarded only as representing the sexual individuals; and it consequently appears that alternation of generations cannot be accepted.—*Comptes Rendus*, December 12, 1881, p. 1032.

On the Phenomena of Division in Euglypha alveolata *and the Monothalamous Rhizopods in general.* By Dr. Aug. Gruber.

The investigations of Dr. Gruber upon the phenomena of the multiplication by division in *Euglypha alveolata* and other Monothalamous Rhizopods reveal important facts in the history of these creatures. They show especially how the envelopes of the body being more or less supple or resistant, influence the mode in which division is effected.

If we group the Monothalamia in accordance with the nature of their covering, we may form a first category for those of which the carapace consists of little plates of various forms produced by the sarcode of the animal itself. It is here that we must place the species upon which the author has made the most complete investigations.

Leidy observed two examples of *Euglypha alveolata* united by their soft parts in the oral region—that is to say, at the orifice of the shell. One of these individuals was at first much smaller than the other; but at the end of an hour it had attained the normal dimensions, and currents of protoplasm passed from one individual to the other. This fact alone seemed to indicate that this was a phenomenon of division rather than of conjugation. But the observation was too imperfect to permit any certain conclusions to be drawn from it. Dr. Gruber has completely elucidated the mode of reproduction in question, by following step by step all its phases in the same individual.

In a well-developed specimen of *Euglypha alveolata* we observe in the region where the nucleus is situated some small very refractive bodies, which preceding observers have regarded as being the little plates destined to form the new carapace after a moult. This interpretation, which is correct so far as the nature of the bodies is concerned, is not so with regard to the part they have to play.

According to Dr. Gruber's observations a certain quantity of protoplasm projects from the carapace through the aperture of the latter. At the same time the little plates just mentioned set themselves in motion, and arrange themselves one behind the other along the wall of the carapace. From this a series is soon seen to issue and arrange themselves round the process of protoplasm that has been expelled through the aperture. The quantity of this protoplasm gradually increases; and at the same time fresh platelets issuing from the parent individual become imbricated upon its surface. In from half an hour to an hour these pieces, about eighty in number, have taken their places, and the new creature has acquired the aspect of a fir-cone; finally, a little later, they present their definitive arrangement, and the *Euglypha* that they protect only differs from that which has given it birth by the absence of a nucleus.

While the carapace is forming, the maternal nucleus undergoes certain changes. Fine granulations or curved lines make their appearance in it. It soon presents movements, slowly changes its form, and finally becomes elongated in the direction of the major axis of the animal. It then shows a longitudinal striation, which grows more and more distinct; and at the same time its length comes nearly to equal that of the animal. Then it becomes constricted and divides into two halves, one of which remains in the original individual, while the other passes into the newly-formed one. After passing away from the point of union of the two *Euglyphæ*, these nuclei lose their striation and are distinguishable only in the form of more transparent spaces.

In the protoplasm a movement of circulation then commences, and takes place both in the interior of each individual and from one individual to the other; this lasts for about a quarter of an hour and then ceases. After some changes of little importance a loosening occurs at the point of union of the two *Euglyphæ*; pseudopodia make their appearance there; and finally the two creatures separate and are equally complete.

The observations of F. E. Schultze on *Quadrula symmetrica*, and those of Leidy on *Trinema acinus*, show that in these two genera the same things evidently take place as in *Euglypha*; that is to say, the platelets protecting the body are produced in the interior of the parent individual, and afterwards conveyed round the body of the daughter individual. M. Gruber has almost completely traced these same phenomena of division in *Cyphoderia ampulla*, the carapace of which is not formed of a comparatively restricted and tolerable constant number of plates, but rather of an infinity of little particles which gives this envelope the aspect of shagreen.

The phenomena of division seem to be nearly the same in the *Arcellæ*.

In the Monothalamia with carapaces formed of foreign materials, such as the *Difflugiæ*, which are covered with grains of sand &c., individuals have been observed united by their buccal poles; and this state has been regarded as the result of conjugation. According to Dr. Gruber this interpretation is incorrect, and the individuals thus joined must be the product of a division on the point of completion. With Bütschli he assumes that these Rhizopods first of all introduce into their bodies the foreign substances which are to serve for the formation of the envelope. The sand-grains, Diatoms, &c. are then transported to the outer surface of the newly-formed individual, just in the same way as the platelets of the *Euglyphæ*, *Quadrulæ*, &c.

The forms which are protected by an inflexible chitinous carapace also present the same mode of multiplication. This would seem to be proved by Dr. Gruber's observations on *Microgromia socialis*, and Schneider's on *Difflugia enchelys*.

On the other hand, in the genera which have an envelope formed by a flexible membrane adherent to the sarcode of the body, division takes place, as in the *Amœbæ*, in the mode that may be denominated normal, because it is that which is by far the most frequent in animal cells. A constriction is produced in the middle of the body, and causes the formation of two individuals.—*Zeitschrift f. wiss. Zool.* xxxv. p. 431, & xxxvi. p. 104 (1881); *Bibl. Univ., Archives des Sciences*, December 15, 1881, p. 624.

The Mediterranean Species of Fierasfer. By Prof. C. Emery.

Fierasfer acus, the commonest species in the Mediterranean, attains a length of 19 centim. (about $7\frac{1}{2}$ inches), and takes up its abode preferently in the large Holothuriæ, such as *Holothuria tubulosa* and *Stichopus regalis*. The author has frequently observed the process adopted by the little fish for introducing itself into the body of the Echinoderm. It commences by examining the whole length of the latter until it has discovered at which end the anus is situated. It places its muzzle against this orifice, and then, at the

moment when the sphincter dilates to allow the escape of the water which has served for respiration, it bends round quickly, and gliding its slender tail along its body, passes it in an instant into the cloaca of the Holothuria. This first step taken, the rest of the operation may occupy more or less time. A small *Fierasfer* attacking a large Holothuria sometimes succeeds in making an entrance at once. But should there be any disproportion of size the parasite waits for the respiratory stream to dilate the anus, and then pushes further in: and it is only by long-continued efforts that it finally enters. Prof. Emery has seen as many as seven of these fish successively enter the body of the same individual.

The *Fierasfer* lodges at first in the respiratory tree of the Holothuria, which opens into the intestine not far from the anus; but it is also found in the perivisceral cavity, because the respiratory tree is most frequently torn by the efforts of the little fish, especially when it receives several of them at the same time. The *Fierasfer*, however, is not a true parasite feeding at the expense of its host, but gets its nourishment from the sea by pushing its head out of the Holothuria. The position of its anus, which is placed very near the head, also enables it to evacuate the fæcal matters and the sexual products without quitting its domicile.

This singular fish consequently makes use of the Holothuria as a habitation, or as a refuge from its enemies. It is therefore what we may call a *commensal* in the words of Van Beneden, or, as Prof. Emery expresses it, a lodger-parasite (*inquilinus*).—*R. Accad. dei Lincei, Atti*, ser. 3, vol. vii. 1880; *Bibl. Univ., Archives des Sciences*, December 15, 1881, p. 627.

Mode of Capture of Lizards in Southern Europe. By Dr. T. Eimer.

In my memoir on *Lacerta muralis cærulea* I described the peculiar method, usual in Italy, by which the boys there catch lizards: they make a noose at the end of a long stiff haulm of grass, and fill this with saliva so as to appear like a shining mirror. They hold the grass-haulm towards a lizard, which, being very inquisitive, comes nearer and nearer in order to examine the apparatus, and in the midst of its curiosity easily allows the noose to be drawn over its head.

The celebrated statue of the Sauroctonus*, as is well known, represents a youth, still of tender age, who, leaning with his left arm upon the trunk of a tree, and holding in his right hand a piece of a rod, in a watchful attitude follows with his eyes a lizard running up the trunk of the tree, with the object, as the archæologists think, either of tickling or transfixing it with the above-mentioned rod, as with a dart, a fragment of which the rod would represent. The latter opinion, so far as I know, relates to the statement of Pliny†,

* Σαυροκτόνος, lizard-killer.

† Hist. Nat. xxxiv. 70.

who says, "fecit" (ex ære Praxiteles, to whom he ascribes the statue) "puberem Apollinem subrepenti lacertæ cominus sagitta insidiantem, quem sauroctonon vocant." Apollo is supposed to wish to obtain predictions from the struggles of the dying lizard. An epigram of Martial* relating to our statue runs as follows:—

"*Sauroctonos Corinthius*" [*i. e.* of Corinthian brass].
"Ad te reptanti, puer insidiose, lacertæ
Parce, cupit digitis illa perire tuis."

The lizard, therefore, is creeping up to the boy. This and the whole bearing of the Sauroctonus, which is quietly expectant and almost negligent, the attitude of the right arm and hand, the mode in which the latter holds the rod in its fingers, lightly and easily, not firmly and securely as one holds a dart with which one intends to kill, and, lastly, the peaceable expression of the face, indicating sport rather than any thing serious, all appear to me to show most definitely that in the Sauroctonus we have before us a boy waiting for a lizard with a grass noose and not with a dart. It is by this explanation that the whole statue becomes intelligible, and appears in all its harmonious truth to life.

It is well known that there is in the Vatican a copy of the original in marble, which was dug up on the Palatine Hill in 1777; another, smaller one, in bronze, found near S. Balbina, in the Villa Albani, in Rome; another in Paris, &c. The first two I know well by personal inspection. In the best-known and finest of them, that in the Vatican, both arms from the shoulders are new. In the example in the Villa Albani the arms are old; according to one of the statements accessible to me at the moment, the right hand has, however, been restored in this†. Be this as it may, the attitude of the right arm, hand, and fingers in both cases is such that it can be connected only with the light and easy holding of a grass-haulm, and not of a dart. I would, however, lay the chief stress upon the other characters of the statue, which, as already stated, can only be brought into accordance with the former conception.

It would be interesting to know whether the method of capturing lizards with the noose is practised in Greece, as is very probable, considering the old relations of the Greeks and Romans; but even if this should not be the case, these relations would suffice to have given Praxiteles the material for his statue.

Thus the practice of this method would be shown to be very ancient. To what ancient times similar practices may be traced back, how tenaciously they transmit themselves to later ages and maintain themselves therein, is proved by a fresco painting in the Etruscan Museum of the Vatican, representing a boy who allows a

* xiv. 172.

† In the example in Paris also the right forearm and hand are new, as also the fingers of the left hand.

bird held by a thread attached to its legs to flutter about. This is a practice which is still one of the commonest acts of the daily cruelty to animals witnessed in Italy, and has consequently occupied thoughtless human creatures at least since the time of the Etruscan people, which loses itself in the obscurity of an unknown past.—*Archiv für Naturgeschichte*, xlvii. (1881) pp. 514–516.

Note on some obscure Points in the Organization and Development of the Echinorhynchi. By M. Mégnin.

The *Echinorhynchi* are generally regarded as entirely destitute of a mouth and digestive organs. M. Lespés has described what he thought was a digestive organ in the trunk of *Echinorhynchus gigas*; but his view has not been adopted by subsequent authors; and M. Mégnin thinks that the cavity that exists in the interior of the trunk is the result of a disposition rendered necessary by the alternate erection and retraction of the trunk, like the finger of a glove, frequently observed in these worms.

His own investigations have been pursued for several years upon different species of *Echinorhynchi*, both adult and in the state of encysted larvæ, obtained from fishes, reptiles, birds, and Cetacea; and he states that, although the cavity of the trunk may not be a digestive organ, such an organ nevertheless exists. In many *Echinorhynchi* there are two pyriform organs, which open at the base of the neck in the species which have not the trunk sessile, and at the base of the trunk in those which have no neck. These organs, called *menisci*, were regarded by Dujardin as a salivary apparatus; but all other helminthologists have confessed ignorance of their significance and function. In some encysted larvæ of *Echinorhynchi*, obtained from the cellular tissue of *Varani* and of a pheasant, the author found that these menisci filled the cavity of the body and opened at the base of the trunk in a large buccal pore with finely-folded lips. In a specimen of *Echinorhynchus brevicollis* from the whale the menisci were replaced by two long cylindrical tubes, opening into a furrow at the base of the trunk, and extending to the extremity of the body on each side of the generative organs. The interior of these tubes was lined with polygonal cells strongly impregnated with fat-globules of a reddish-yellow colour; and the author describes them as presenting a complete analogy with the bifid intestine of certain *Distoma*.

This intestine exists in the encysted larvæ of the *Echinorhynchi*, but is atrophied and represented only by the menisci in most of the adults, although, as above stated, it persists in some. The fact of the presence of a bifurcate intestine in the *Echinorhynchi* approximates those worms to the Trematoda, and removes them from the Nematoda, with which they have hitherto been classed.—*Comptes Rendus*, December 12, 1881, p. 1054.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 51. MARCH 1882.

XVII.—*The Sponge-fauna of Norway; a Report on the Rev. A. M. Norman's Collection of Sponges from the Norwegian Coast.* By Professor W. J. SOLLAS, M.A., F.R.S.E., &c.

[Plates VI. & VII.]

[Continued from vol. v. p. 409.]

Order TETRACTINELLIDA, Marshall.

Group *GEODINA*, Carter (*continued*).

Genus PACHYMATISMA, Bwk.

Pachymatisma Johnstonia, Bwk.

Alcyonium primum, Diosc. (?), Donati, Hist. Nat. de la mer Adriat. (1758).
Halichondria Johnstonia, Bwk. Trans. Micr. Soc. vol. i. p. 63, pl. vi. (1841); Hist. Brit. Sponges, Johnst. p. 198 (1842).
Pachymatisma Johnstonia, Bwk. Monogr. Brit. Spong. ii. pp. 3 & 51; O. Schmidt, Zweites Suppl. Spong. d. Adriat. Meeres, p. 12 (1866); Carter, Ann. & Mag. Nat. Hist. 1869, vol. iv. p. 11.
Caminus osculosus, Grube, Mitth. ü. St. Malo u. Roskoff, p. 132, pl. ii. fig. 3 (1873).

Bowerbank's faithful description of this sponge renders unnecessary any thing more than a supplement on some points of its histology.

1. *The Cortex.*—(i) The outermost layer of the cortex is an exceedingly thin, colourless, and transparent membrane, which rests on a layer of bacillar spicules, homologous with the layer of minute stellates in other Geodine sponges.

(ii) The bacillar layer is single, *i. e.* only one bacillus thick, the bacilli lying parallel to its surface, orientated in every direction, in close contact with each other. Since there is nothing intervening between the superficial membrane and the bacillar layer, it is clear that the former must be the ectoderm, if the generalization hold good that all the skeletal parts of the sponge originate in the mesoderm. That it now exhibits no ectodermic structure is in full accordance with Schulze's observations, who states that he has never yet seen the characteristic platten-cell outlines in spirit-specimens, but only in fresh specimens under silver or gold treatment.

(iii) The succeeding dermal layer is described by Bowerbank * as "a stratum of membranous structure and sarcode destitute of gemmules (globates)." It is of very variable thickness, in some places 0·0038 to 0·0075 inch across, in others absent, the underlying globates then coming in contact with the bacillar layer; it closely resembles the vesicular or vacuolated connective tissue of *Geodia Barretti* (see *anteà*, vol. v. p. 251); in some parts it consists simply of separate colourless, transparent, more or less oval, or polygonal cells with remarkably thin walls and devoid of contents, except for a very small quantity of colourless sarcode, in which may usually be detected a nucleus with its nucleolus (Pl. VI. figs. 5 and 13); in other places, however, the tissue exhibits in addition an intermediate substance, which joins the adjacent cells together, and appears to result from the metamorphosis and fusion of their walls; the intermediate substance is usually colourless and structureless; but sometimes it assumes a dusky grey tint, owing to the presence of abundant minute granules; it also appears in some cases to become finely fibrillated (Pl. VI. fig. 5).

(iv) The globate layer, 0·03 inch thick, has the same structure as in other Geodine sponges. The ligaments which join adjacent globates together consist of fine structureless parallel fibrillæ, amongst which at intervals occur parallel-lying granular threads, sometimes containing a nucleus and nucleolus (Pl. VI. fig. 11). They are probably derived, like the connective-tissue fibres, from elongated fusiform cells with hyaline walls and granular axial threads, in which the hyaline walls have become completely fibrillated, while the axial thread remains unchanged.

* Phil. Trans. 1862.

(v) The subcortical layer is similar to that of *Geodia Barretti*.

2. *The Mark.*—This is chiefly composed of a granular connective tissue like that of other Geodine sponges, but partly also of vesicular connective tissue; in places groups of granular protoplasmic cells, containing a number of highly refractive globules resembling oil-drops, are met with. The ciliated chambers measure about 0·001 inch in diameter.

3. *The Canal-system.*—(i) *Incurrent canals.* Commencing with an examination of the surface of the sponge, we find that *pores* are not universally distributed over it, some parts being quite destitute of them; and in these places transverse sections of the crust prove the corresponding absence of chones. In the poriferous surface we can frequently distinguish a number of roundish or polygonal opaque white areas, separated by slightly more translucent interspaces; in these areas are set the pores, a group of six to ten pores in each, though sometimes only one or two are visible, or, it may be, even none. If the tissue bearing the pores be removed from the sponge and examined in glycerine under the microscope (Pl. VI. fig. 4), it will be found to consist of a layer of dermal vacuolated tissue, covered by the epidermal and bacillar layers; between adjacent groups of pores, and serving to define them from each other, a row of globate spicules replacing the dermal tissue is seen in addition. The dermal tissue forms a thick framework between the pores, but thins out towards their margins, leaving these to be constituted by the epidermal and bacillar layers alone. It is quite clear that these pores, although doubtless capable of opening and closing by iris-like movements of the clear marginal membrane, are not vague and transitory, as has been asserted, but, on the contrary, persistent and well defined. In my specimens they are usually elliptical in form. With regard to their size, concerning which much confusion exists in published writings, I find that the diameter averages about 0·075 inch; sometimes it becomes as much as 0·12 inch, or as little as 0·002 inch. The majority are clearly visible to the naked eye. On examining the surface from which the poriferous layer has been removed, it will be found that a chonal cavity lies beneath each cluster of pores; the opaque white areas in which they are set are thus in fact chonal roofs, the opacity and whiteness being due to the absence of the globate layer beneath them.

The chones, of which we have next to speak, are closely similar to those of *Geodia Barretti*; they were first described

by Bowerbank *, and afterwards more fully by Carter †. My own observations, made on thin slices mounted some in glycerine and some in balsam, all showing the structure in the clearest possible manner, are different from those of Carter in several particulars, and accord with those made by me on *Geodia Barretti*. A transverse section of the rind, giving a longitudinal section of the chones, is represented in fig. 3, Pl. VI. The chonal roof consists of the epidermis and bacillar layer above, bearing the pores; beneath follows the vacuolated tissue, with interspersed fibrous elements concentrically surrounding the pore-canals, which descend one from each pore. The pores in the centre of the roof lead directly into the chone, those at its sides into lateral canals, which may be regarded as an extension laterally of the main chonal cavity above the globate layer and beneath or through the dermis. They are best exposed in tangential sections of the chones. There is no trace of small independent canals traversing the crust outside the chones. The ectochone has the form of a truncated cone, the base being directed outwards; it is provided below with a well-developed sphinctral muscle, the origin of which is about on a level with the inner face of the globate layer; the endochone has almost or entirely disappeared, and the subcortical crypt is of very variable size and irregular form.

The epidermis and its associated bacillar layer are continued from the pores inwards, lining the poral canals and the whole cavity of the chone; they extend through the aperture of the sphincter (the bacilli becoming very rare here), and cover the walls of the subcortical crypt. Beneath the bacillar layer in the walls of the ectochone is a layer of dermal vacuolated tissue, about 0·002 inch thick; it lies immediately on the globate layer.

The chonal sphincter varies in thickness according to its degree of contraction; when fully closed, its lower side has a mamillary form and projects into the cavity of the subcortical crypt; this swollen protuberance may have given rise to the notion of a spiral tube descending from the sphincter, which does not really exist. It is covered by small roundish cells, which are most clearly seen at its central margin, and which are, without doubt, ectodermal. It consists chiefly of dark granular muscle-fibres, which stain deeply with carmine; they have a concentric and radiate arrangement, but are mostly concentric.

(ii) *The Excurrent Canals*. The same differences as dis-

* Brit. Spong. vol. i. p. 101.
† Ann. & Mag. Nat. Hist. 1869, vol. iv. p. 13.

tinguish the excurrent and incurrent canals in *Isops* are to be met with here.

The ultimate excurrent canaliculi flowing from the flagellated chambers join together into larger canals; and these, after one or more confluences, empty themselves into one or other of the main excurrent trunks, which, maintaining a tolerably uniform diameter for a considerable part of their course, at length open freely into a large, more or less spherical chamber (Pl. VI. fig. 1, C, fig. 2, *b*); this chamber communicates, through an aperture guarded by a thick muscular sphincter, with a smooth-walled cylindrical tube (fig. 1, T, fig. 2, *a*), the external opening of which is somewhat reduced by an extension inwards of its surrounding margin. The walls of this tube, as well as its outer rim, consist of vacuolated tissue, covered by the epidermis, dermis, and bacillar layer; the vacuolated tissue extends down to the subcortical layer, which here consists of gelatinous connective tissue of the usual composition (fig. 1, *c*), bacilli, and long, delicate, thread-like fibres, a little swollen, granular, and nucleated in the middle, and directed lengthwise towards the sphincter; the free face of the subcortical layer, which here forms the wall of the spherical chamber, is covered by a dense layer of dark grey granular fibres (fig. 1, *f*).

The vacuolated tissue of the outer tube exhibits as it approaches the sphincter an increasingly large admixture of fibres, which appear partly to arise between its cells, partly to be introduced from the globate layer.

The sphincter is formed by the union of the subcortical tissue with that of the wall of the outer tube. When these two meet they assume a common direction, so as to extend across the axis of the tube; the tissue of the outer tube forms the upper part of the sphincter, and is traceable as a distinct component almost close up to its centre; it gives us the distinct small epidermal cells covering the upper surface, the bacilli beneath, and lower still the vacuolated cells intermixed with granular fibres. The subcortical layer forms the lower two thirds of the sphincter; it furnishes the layer of epithelial cells covering the lower face of the muscle; its outer dark granular fibrous layer sweeps into the lower part of the sphincter, increasing in thickness as it goes; while its gelatinous connective tissue constitutes the middle layer of the sphincter, extending into it as an intrusive wedge-like mass. Near the centre of the sphincter all these various constituents, except the epidermal and epithelial layers, are represented by dark-grey granular muscle-fibres alone, which, taking a concentric, radiating, and vertical direction, form a

central bobbin-shaped mass, easily distinguished from the other constituents by its dusky tint and the deep stain it takes with carmine. One must not omit to mention that amongst the muscle-fibres abundant bacilli occur thickly dispersed. These little spicules indeed pervade the whole of the sphincter, as much in one part as another: but it contains no stellates; these first appear in the underlying spherical chamber, the walls of which are lined by stellates and bacilli together.

The Skeleton.—The *bacilli* are clearly homologous with the minute dermal stellates of *Geodia*, their distribution in the sponge being precisely similar; in both sponges these dermal microliths pass through the cortex and enter the mark, into which, however, they extend only a little way, soon disappearing as we trace them towards the centre of the sponge, their place being taken by the larger stellates proper to the mark.

This homology is a point of some interest, since, taking into account the close family relations of *Geodia* and *Pachymatisma*, it clearly indicates for the bacilli and stellates a common origin; and the question arises as to which of the two is the more primitive form. Examining first their ontogeny, we find it possible to trace the bacillus from the adult form, cylindrical with rounded ends and roughened surface (like a comfit), to a smooth fusiform spicule with a central globular enlargement and pointed ends (fig. 10 *b*), which we may regard as a biradiate stellate.

From this we pass to a form in which the central enlargement has disappeared, and then finally to a fine hair-like rod (fig. 10 *a*), remarkably similar to one of the trichites of which the trichite-sheaves of *Stelletta Normani* are composed.

Turning next to the minute stellate of *G. Barretti*, we are able to trace it backwards, its thick rays becoming of hair-like fineness, and the whole progressively smaller, until it can be no longer followed under a Zeiss-H immersion lens; and yet it remains a multiradiate stellate to the end. Thus, from ontogeny we seem here to get no help at all. The two forms differ greatly in respect of variability, the minute stellates showing but little constancy in the number of their rays, some possessing twice as many as others; while the bacilli, on the other hand, are remarkably stable, seldom varying at all; now and then they sprout off a third ray (fig. 10, *d*, *e*), but so rarely that one has to look long for an instance. Since when once the stability of a form is disturbed it often continues to present variations, we might hence regard the bacilli as the original undisturbed forms, and the stellates as the variable descendants of a bacillus-sport.

The *stellates* of the mark possess a comparatively small number of rays, a character in curious consistency with the substitution of biradiate bacilli for multiradiate dermal stellates in this genus; six or eight rays is a common number; as many as twelve may occur; but reduction to four, three, or even two, is frequent. With only two rays in the same straight line, the spicule presents a central globular enlargement and looks like a magnified copy of a young bacillus.

A study of the various forms of these stellates is a study of nearly all the characteristic forms of spicules which distinguish the various groups of sponges: hexactinellid, tetractinellid, triradiate are all here, and a great number of other forms besides. We seem in these spicules to have the results of unhindered variation, freed from the conditions imposed by a selective environment.

The *long-shafted spicules* in the specimen under examination exhibit a great variety of monstrous growths: in many a number of siliceous globules cover as excrescences one end of the spicule (fig. 9); in others one end becomes bifid, trifid, or even quadrifid (fig. 6), the last deviation being met with in the usually simple proximal end of the shaft of a tetractinellid form; some, again, possess simple ends, but a double body (fig. 7); and, finally, in one instance the end of a spicule has sprouted out rays which are arranged in a combination of prong and anchor endings in one (fig. 8). Since anchors do not occur normally in *Pachymatisma*, this variation is of particular interest. Bowerbank has already remarked, in his description of the species, on the great variety of these spicules, and particularly says that their radii are frequently bifurcated or contorted to a great extent. This, and the irregular disposition of the trifid spicules, is worthy of notice in connexion with the possibility of a transition from the trifid to the quadriradiate Tetractinellids and the Lithistids.

Many of the spicules appear to be subject to some disease, by which the central canal has been enlarged till it occupies one third of the entire diameter, the axial thread remaining as a straight sharply defined rod of the usual size; sometimes it projects quite freely at the end of the spicule.

By manipulating the cover-glass over a teased fragment of the sponge the axial thread could be "wriggled" out nearly entire from the spicule. It is faintly bluish, transparent, structureless, very flexible, like a piece of sewing-thread, and takes a decided stain with magenta.

Some of the spicules are united where they touch in crossing each other by some tough brown-coloured matter, which stains with magenta and looks like spongin.

The *globates* agree in their general character and mode of development with those of other Geodina; and I have now only to allude to the statement that in their young form they closely resemble stellate spicules. This I cannot substantiate; closely as I have searched for transitional forms between globates and stellates, I have never yet been able to find any, any more than between stellates and bacilli. In thin slices mounted in balsam I have been able to trace the globates down to a young form, measuring something under $\frac{1}{1200}$ inch in diameter; but even in this earliest stage it consists of a vast number of minute trichites united into a central globule at their inner ends. Its outline is spherical, owing to the trichites ending at the same distance from the centre; and it is enclosed in a granular cell with a large young nucleus on one side, which takes a deep tint with carmine. It thus differs from a young stellate in just the same way as the stellate from a bacillus, *i. e.* by a great difference in the number of its rays. As the globate increases in size, each trichite becomes longer, thicker, and roughened over its free end, so as to resemble closely an adult bacillus. The globate, indeed, might now be well compared to a collection of bacilli, radiately grouped and fused together at their inner ends.

Classification.—The generic distinction of *Pachymatisma* is well founded, and is further supported by the character of its oscular openings.

In *Geodia Barretti*, which we regard as an illustrative species of the genus *Geodia*, we likewise have an oscular tube; but it differs in a most important manner from that of *Pachymatisma*; for while the latter is separated by a sphincter at its base from a common chamber below, in which the excurrent canals open freely by unconstricted apertures, the former, on the other hand, is without the common chamber and the common sphincter, and the excurrent tubes are severally and separately sphinctrated as they open directly into the oscular tube itself. In *Geodia* the oscular tube appears to result from the union of a number of excurrent chones, like those of *Isops*; in *Pachymatisma* it is produced by the over-development of a single one. In *Cydonium* there are no oscular tubes, and both excurrent and incurrent chones (if the distinction can here be maintained) are covered with a cribriform or poriferous roof, the very reverse of what holds in *Isops*, where neither excurrent nor incurrent chones are so provided. Translating the foregoing distinctions into a different nomenclature, it would seem that in *Isops* we have a compound stock consisting of a number of separate individuals, somewhat resembling an *Astræa*-stock amongst corals; in *Geodia* groups of these

individuals have become united into individuals of a higher order; in *Pachymatisma* single individuals have become more complicated by a branching or budding off of main excurrent canals, which are here to be regarded each as an individual of a lower order; in *Cydonium* we appear to have a case of lipostomism, the functions of an osculum being vicariously carried on by the poriferous chones.

Indicating the individual expressed by a single excurrent chone by the symbol 1, and that expressed by a single main excurrent canal by I, we may briefly formulate the relations of the four genera in the following diagram:—

Isops	1 . 1 . 1 . 1 . 1 . 1 . 1 .
Geodia	(1 1 1) (1 1 1 1)
Pachymatisma	0 . 0 . 1 . 0 . 0 . 0 . 1
	$\overbrace{\text{I . I . I . I . I}}$ $\overbrace{\text{I . I . I . I . I}}$
Cydonium ?	No obvious individuality beyond that of the entire stock.

Distribution. Kors Fiord, Norway, Station 23: 180 fathoms. Bowerbank cites this sponge from Torquay, south coast of Ireland, Orkneys, and Wick, Scotland. We now have it from Norway; and Grube describes it, as pointed out to me by Mr. Norman, under the name of *Caminus osculosus* from St. Malo. It thus extends from Norway and the Orkneys on the north, to St. Malo on the south, and as far west as the Guliot caves on the south coast of Ireland; bathymetrically, it ranges from low-tide level to 180 fathoms.

Group *Tetillina* (*Tethyina*), Carter. (Pl. VII.)

Genus Tetilla, O. S.

Tetilla cranium, Müll.

1789. *Alcyonium cranium*, Müll. Zool. Dan. t. 85. f. 1.
1815. *Tethya cranium*, Lmk. Mém. d. Mus. i. p. 71.
1816. *Alcyonium cranium*, Lmx. Hist. d. Polypes, p. 347.
1818. *Spongia pilosa*, Mont. Mem. Wern. Soc. vol. ii. p. 119, pl. xiii. figs. 1–3.
1828. *Tethya cranium*, Flem. Brit. Animals, p. 519.
1834. *Tethya cranium*, Blainv. Mém. d'Act. p. 544.
1842. *Tethea cranium*, Johnst. Brit. Spong. p. 83, pl. i. figs. 1-8.
1864. *Tethea cranium*, Bwk. Monog. Brit. Sp. i. p. 182, pl. xxxi. fig. 362.
1866. *Tethea cranium*, Bwk. Monog. Brit. Sp. ii. p. 83.
1866. *Tethya cranium*, O. S. Adriat. Spong. ii. Suppl. pl. i. fig. 14.
1867. *Tethya cranium*, Gray, P. Z. S. p. 543.
1870. *Tetilla cranium*, O. S. Spong. Atl. p. 66.
1871. *Tethya cranium*, Carter, Ann. & Mag. Nat. Hist. vol. viii. p. 101.

1872. *Tethya cranium*, Carter, Ann. & Mag. Nat. Hist. vol. ix. p. 419, pl. xxii. fig. 9.
1874. *Tethya cranium*, Bwk. Monog. Br. Sp. iii. p. 315, pls. xiv. & lxxxix.

This interesting sponge, the occurrence of which in the Norwegian seas had been early noticed by Bishop Pontoppidan (Lamx. *loc. cit.*), is well represented in Mr. Norman's collection by several small but perfectly preserved specimens. A clear insight into its exquisite structure is afforded by a series of thin slices obtained by means of the freezing microtome, and mounted in balsam or glycerine. My chief regret is that its beauties have not found a more skilful pencil to portray them.

The sponge is approximately spherical in form, white, and with a hairy appearance due to the projection of the ends of the spicular fibres beyond its general surface. An oscule is clearly present, though Bowerbank and other observers have failed to find it. On this point Bowerbank is most explicit; his specimens were some two hundred in number, and, after careful searching, he could discover no trace of an oscule, pores, or intermarginal cavities, all of which in Mr. Norman's specimens can be easily demonstrated. Carter, it should be added, has called attention to the presence of a group of oscules in a specimen which came under his observation (Ann. & Mag. Nat. Hist. ser. 4, 1872, vol. ix. p. 419).

The oscule is a nearly circular opening, usually small (from 0·03 to 0·07 inch diameter), obliquely terminating a tunnel-like tube (fig. 6, *o*, transv. sec.) which runs for a short distance along the surface of the sponge; the tunnel-like roof of the tube is a thin imperforate membrane formed by the extension of the dermis; the floor is the ordinary dermis of the general surface, which retains its pores, and by their over-development assumes the character of a fenestrated membrane or network with round meshes.

The skin or dermal membrane rises tent-like about the ends of the projecting spicular fibres, and extends continuously from one to another, so as to completely invest the sponge. It is best seen by cutting off the ends of the projecting spicules, and viewing under an inch lens by reflected light (figs. 15, 16). One can then observe shining through the surface of the skin a number of thread-like fibres, which radiate outwards and downwards from the circumference of each spicular fibre as a centre, branching as they go, and anastomosing with those of adjacent centres to form a polygonal network, by which the overlying dermal membrane is mapped out, as it were, into a number of polygonal areas.

It is in these areas, which may be even and plain, or subdivided by smaller fibrous threads into a number of round or oval spaces, that the pores are situated: they are very small, from 0·001 to 0·002 inch in diameter; and the poriferous membrane is so tender and delicate that it would probably be torn away by an observer unsuspicious of its presence, and in this way may have escaped the notice of Bowerbank; when removed, the projecting spicular fibres appear below, each rising out of a fleshy papilla, the lower half of what we shall term a spicular column of the cortex. A good representation of the surface of the sponge, as thus denuded of its dermal membrane, is given by Johnston (*loc. cit.* pl. i. fig. 3). The spaces between the papillæ (Pl. VII. fig. 6), roofed over by the dermal membrane in the uninjured sponge, correspond to the intermarginal or subdermal cavities of other sponges.

Bisecting the sponge through its oscule, we distinguish on the cut face an external whitish rind and a pale greyish mark sharply defined from it; the skin and subdermal cavities are readily observable, forming the outer half of the rind; its inner half is a continuous whitish layer. In the mark, numerous canals are seen cut across; and one large one approaching close to the oscule, along a spiral course conformable to that of the spicular fibres, is clearly one of the main excurrent canals.

We now proceed to give a more detailed account of the structure of the sponge, as revealed in thin slices examined under the microscope.

The Ectoderm.—The study of this layer is full of perplexing difficulties, owing partly, no doubt, to the fact that one is limited to particular methods in investigating it, but partly also to the want of constancy in those characters which it clearly displays. It is in the subdermal cavities that its structure is most satisfactorily seen. There, on the sides of the spicular columns (Pl. VII. fig. 13) one may sometimes discover it as a superficial layer of irregularly polygonal plate-like cells, $\frac{1}{1500}$ to $\frac{1}{2500}$ inch in diameter, with small circular nuclei of a faint bluish tint, $\frac{1}{7500}$ to $\frac{1}{10000}$ inch in diameter, which sometimes project outwards beyond the plane of the membrane. This structure, by the loss of the polygonal outlines of its cells, readily passes into a thin membrane with scattered nuclei, of just the same size and appearance as those in the well-defined cells. If this were the only change, no difficulty concerning the ectoderm of the subdermal cavities need be felt; but in some places the minute C- and S-shaped spicules of the mesoderm are plainly imbedded

in the nucleated membrane, each spicule surrounding a nucleus, which does not differ in any apparent respect from those of the plate-like polygonal cells. There can be no question that these minute spicules and their nuclei are associated parts of the same cell; but how comes this cell into the ectoderm if all spicular structures are a product of the mesoderm? Can a mesoderm-cell have wandered into the ectoderm? and if one kind of mesoderm-cell why not others? and then what becomes of the sharp distinction between these two layers? The simplest explanation would, of course, be that of mistaken observation; but, after repeated examination of my preparations, I can see no reason for admitting this. But this is not all; for in many places a thin annular wall appears about the small round nuclei (Pl. VII. fig. 9), whence results a flat oval cell about $\frac{1}{2000}$ inch in diameter, devoid of contents except for a little clear colourless protoplasm, which may form a little slightly granular heap about the nucleus and extend from it to the outer wall; the appearance of the lining membrane is now that of a thin structureless film imbedding flat oval cells, at intervals varying from that of their own diameter up to close contact. No other structure can be seen more superficial than this, either when viewed face on or in transverse section, and consequently, one can scarcely help regarding it as the ectoderm; it is at least conceivable, though not probable, that it results from a change in the form of the plate-like cells, consequent on immersion in spirits; if these, on shrinking, assume an oval form and become connected by an exudation from the mesoderm which subsequently hardens, an appearance similar to that described might be produced.

The skin (Pl. VII. fig. 7), as the outer covering membrane may be briefly called, exhibits another change of structure. This consists in the appearance of an immeasurably thin structureless membrane, which is in many places thrown into numerous minute wrinkles having no apparent arrangement, except when traced to the margins of the pores, to which they are radiate. It rises tent-like about the projecting spicules individually. Associated with it, but lying on its under surface, as can be clearly perceived by examining it in optical section where it rises into tent-like projections or is most wrinkled, are the circular pale bluish nuclei of the subdermal epithelium, often so regularly disposed at nearly equal distances from each other, that one feels almost bound to regard the nuclei and membrane together as an ectoderm from which the polygonal outlines of cells have disappeared—until one finds round some of these nuclei, and lying on the underside of the membrane,

the same kind of oval annular wall before described. Hamate spicules are also found lying beneath the outer membrane. The interpretation of these observations is most difficult. If the outermost membrane be the ectoderm, why do not at least nuclei appear in it? since they are plainly seen in the subdermal ectoderm, and these have the same appearance as the nuclei which here occur below the outer membrane. If it is not ectoderm, but a structureless cuticula, where is the ectoderm? for it appears very improbable that a heterogeneous layer of oval cells, spicule-cells, and bare nuclei can represent this layer; by no means impossible, however, since, in spite of the beautiful demonstrations we have had from the masterly hand of F. E. Schulze, I do not yet feel quite convinced of the uniformity of this structure over all parts of the sponge, or that it presents the same constancy as in the other Metazoa. But it is reckless to speculate in the absence of any of the evidence possible, and the silver treatment may eventually, as I almost expect, bring out of the apparently structureless cuticula the polygonal outlines of epithelial cells; but, till that welcome sight appears, one must be content to take the facts as one finds them; and so provisionally the outermost layer is for me a cuticula, and the mixed cellular layer beneath a heterogeneous ectoderm. The cuticula and ectoderm together cover the exterior of the sponge, except in some cases near the small oval pore-areas (Pl. VII. fig. 15), which are situated in the meshes of the polygonal dermal network; in these it often happens that the cuticula is absent, or has thinned away beyond one's power of observation; for, although present on the surrounding skin, it is not possible to see what becomes of it as it is traced into the pore-area. The membrane in which the pores in these instances are set appears, when looked down upon from above, to consist of a structureless film which does not stain with carmine, and in which are imbedded granules, naked nuclei, similar nuclei surrounded by hamate spicules which often project out of the membrane, and flat oval-walled cells with similar nuclei; thus it has the same appearance as the ectoderm of the subdermal cavities. In addition, fine delicate filaments may be seen, which frequently run parallel in groups, crossing one another in the space between two pores, and then diverging so as to touch tangentially the edge of the pores. In the dermal network which forms the floor of the oscular tube and the roof of the subdermal cavity below, we can perceive a similar structure (Pl. VII. fig. 8); but transverse sections show here a superficial ectodermal layer with a thin mesodermic layer between, where the network is thickest; in the very thin layer which

lies between two pores the ectodermal layers come nearly into contact, though a few fine fibrils still seem to separate them; they clearly show, however, imbedded in their midst, and not lying below them, the characteristic round nuclei with hamate spicules surrounding them. These thin and narrow trabeculæ seldom contain oval cells; they are not wide enough; but these, along with granular cells, occur in the larger nodal areas where three or more trabeculæ meet (Pl. VII. figs. 9 & 10).

The edges of the pores are sometimes bordered by minute granular fusiform cells with a minute spherical nucleolus in an oval nucleus.

Between the upper and lower ectodermal layers of the skin is a layer of mesoderm of somewhat variable character, but mainly consisting of a clear colourless jelly-like matrix, in which are imbedded various cellular elements (Pl. VII. fig. 2). The most widely diffused, perhaps, are little circular or oval rings $\frac{1}{3000}$ inch in diameter, highly refractive, and of a pale bluish tinge, enclosing round nuclei $\frac{1}{10000}$ inch in diameter, of similar optical characters; these, scattered irregularly through the clear ground-mass, give it a curious appearance like spotted muslin. Immediately beneath the annular cells of the ectoderm succeed a number of separate, irregularly rounded, granular greyish-coloured cells with round nuclei; they might very well be an early form of the annular cells. Sometimes they form a layer two or three cells deep, sometimes thin out altogether. The remaining cellular constituents are fusiform granular cells, variously distributed; lying parallel side by side, they form the fibrous strands, which run just below the epidermis to map out the pore-areas from each other; sometimes they form a thin layer beneath the surface, in which they wander in all directions, and occasionally extend singly at right angles to the surface from the upper to the lower ectodermic layer. Approaching the spicular columns the dermal mesodermic layer thickens out, so that the upper and lower ectodermic layers become gradually more and more separated from each other—the upper rising tent-like about the outer ends of the spicular columns, the lower descending in a similar but inverted tent-like curve down the continuations of the columns beneath the skin, and so rounding off the upper corners of the intermarginal cavities. In correspondence with this thickening-out of the dermal mesoderm, its fusiform fibres diverge fan-like as they enter the spicular column, the more superficial ones running parallel to their respective surfaces. The fusiform fibres in the vicinity of the spicules run parallel to them, though near

the external ends of the spicular columns they appear to run at right angles to them, and appear to unite with them by their frayed and expanded ends.

At its base the spicular column expands by a thickening of the mesoderm as it extends along with the ectoderm over the upper face of the fibrous layer of the cortex, to form the floor of the subdermal cavities. Below this superficial stratum the fibrous layer consists of similar fusiform fibres to those of other parts of the mesoderm, but surrounded by a more condensed layer of matrix; they are about $\frac{1}{160}$ inch long, $\frac{1}{10000}$ inch wide, highly refractive, faintly bluish, granular, with an oval vesicular nucleus and round refractive nucleolus; the surrounding mesoderm, the walls of these cells, is clear, colourless, and sometimes slightly fibrillated. The inner face of the fibrous layer is coated with an adherent granular mark.

The fibrous layer is traversed by the smaller fusiform acerate spicules represented by Bowerbank (Brit. Spong. vol. i. fig. 362), which run through the fibres like stakes through wattlework. In Bowerbank's figure these spicules all lie parallel to each other, at right angles to the general direction of the fibrous layer; but in none of my slices is such an arrangement to be seen; the majority of the spicules run obliquely through the fibrous layer, sloping convergently towards the spicular columns at their base, and midway between crossing each other obliquely in different directions, some running at right angles to the fibres. The fibres of the fibrous layer lie concentric with the surface of the sponge, running in winding curves orientated in all directions, like the similar fibres in the cortex of *Stelletta Normani* (Ann. & Mag. Nat. Hist. 1880, vol. v. pl. vi. fig. 3). The deeper half of the fibrous layer has a duskier, darker tint than the more superficial, and takes a deeper stain with carmine. As to its function, it is probably a fibrous connective tissue, as I previously asserted of the corresponding layer of *Geodia Barretti* (Ann. & Mag. Nat. Hist. vol. v. p. 253).

The fibrous layer becomes still more modified in the same direction immediately about the incurrent canals, a little below the middle of their course through it; here the fusiform axial threads are more closely approximated, the intervening tissue is of a darker grey, and the stain with carmine strikingly marked; the arrangement of the fibres is for the most part very regularly concentric; but a few are radiately disposed. With this change in appearance there is a change of function, and the fibres form a true muscular sphincter, which is to be observed in the prepared slices in all stages of

contraction. It is clear from the preponderance of the concentric fibres that the chief work done is in the contraction and closure of the sphincter; its return, on the relaxation of the concentric fibres, to a completely open state is completed by the opposing radiate fibres. This sphincter (Pl. VII. fig. 6) is precisely homologous with the chonal sphincters of Geodina and Stellettina. The fibrous layer with its spicules is homologous with the fibrous globate layer of the Geodina.

The Mark.—The mesoderm of the mark chiefly consists of a clear transparent matrix densely charged with more refractive, transparent, minute round granules ($\frac{1}{10000}$ to $\frac{1}{50000}$ inch in diameter), so thickly strewn that they appear almost in contact, and so evenly that no place seems to contain more than another: here and there at intervals small nuclei appear; and the mark surrounding them takes a deeper stain with carmine than elsewhere. If such a tissue as syncytium exists anywhere, then surely it is here. Fusiform fibres occur in the vicinity of the spicule-fibres, running parallel to the spicules, and also about the large water-canals, building around their course an indefinite fibrous layer. Most markworthy are certain large granular amœbiform cells with characteristically large oval nuclei and round nucleoli, like amœbiform ova, which are found embracing the spicules (Pl. VI. fig. 17) as though they were wandering cells creeping along them.

The endodermic cells of the flagellated chambers contribute a large share to the substance of the mark; they now appear as spherical vesicles $\frac{1}{3000}$ inch in diameter, containing a spherical nucleus $\frac{1}{10000}$ inch in diameter, which colours intensely with carmine. Carter has represented one of these chambers in his description of *Tetilla* (Ann. & Mag. Nat. Hist. 1872, vol. ix. pl. xxii. fig. 7), but has mistaken it for an ovum.

The Ova.—Sparsely scattered without apparent order through the mark are a number of very variously-shaped *Amœba*-like cells, distinguished by their disproportionately large nucleus and nucleolus. They occur of all sizes, from $\frac{1}{1200}$ inch diameter to $\frac{1}{180}$ inch, and are without doubt the ova in various stages of development. As soon as they attain a size of about $\frac{1}{700}$ inch across they occupy a distinct cavity in the mark, which serves as a brood-chamber. Pseudopodial extensions, which may become branched, proceed from them, and, passing out of the brood-chamber, wander for a considerable distance on the surrounding substance of the mark. No trace of fibrillation could be detected in these processes. The large oval nucleus, sometimes $\frac{1}{630}$ inch in diameter, with

its nucleolus $\frac{1}{2500}$ inch in diameter, looking like a globular oil-drop, lies nearer one end of the ovum than the other, imbedded in granular protoplasm, which immediately about the nucleus takes a far deeper stain with carmine than elsewhere. At the end of the cell, away from the nucleus, yolk-granules (for such I take to be the heap of large refractive granules represented at *g*, fig. 5) make their appearance, and increase in quantity with age till the whole cell is crowded with them, except in the immediate vicinity of the nucleus. Some of the yolk-granules appear to present a vesicular form. On the whole, one cannot help being impressed with the similarity of this ovum to that of *Hydra*.

The Spermatozoa.—In the three specimens I have examined no trace of these structures was discoverable; and since the ova occur in every stage of development, the presumption is in favour of the sexes being distinct in *Tetilla*. Large clusters of granules occupy a large part of some specimens; but these are segmentation-spheres of a developing parasite.

The Canal-system.—The characters and arrangement of the pores have already been described. They lead directly into the subdermal cavities, which extend continuously from one spicular column to another, and communicate between the columns with each other. In the floor of each subdermal cavity are the inner ends of several ectochones, separated by the usual sphincter from the corresponding endochones; it is thus clear that each subdermal cavity is equivalent to the outer halves of several ectochones which have become confluent, or, *vice versâ*, that those ectochones of a Geodine which lie in an area bounded by surrounding spicular fibres are equivalent to a single subdermal cavity of *Tetilla*. In *Stelletta Normani* this is neatly indicated by the subcortical crypts, which have just the same distribution below the fibrous cortex that the subdermal cavities of *Tetilla* have above it; they therefore clearly map out the areas which would be occupied by similar subdermal cavities were they present; and it is interesting therefore to find that they receive from the cortex not one but several endochones between each pair of spicular fibres, as shown in transverse section. The incurrent canals, after entering the mark, soon branch, and continue to branch repeatedly; but they give off at once and all along their course minute short canaliculi, which directly enter the flagellated chambers. These are $\frac{1}{1000}$ inch in diameter, nearly spherical, and very numerously developed. The chambers less abruptly communicate with the incurrent system by excurrent canaliculi, which are usually longer than the incurrent, the excurrent canals join together into a main

trunk, which traverses the cortex in a manner not yet observed, and then continues over its surface beneath a tunnel-like extension of the skin in the manner previously described, finally terminating in the osculum.

The Skeleton.—The main spicules, which are collected into fibres, are developed in granular spicule-cells, as will be more fully described in treating of the embryo. The cortical acerates and the fibrous layer are clearly homologous with the globate and fibrous layer of Geodina; and the inference is also deducible that the cortical acerates are likewise homologous with the geodine globates; surprising as this inference is at first sight, it is partly supported by the fact that both are developed in remarkably similar nucleated cells. Again, as the trichite sheaf is homologous with the globate, so it is also homologous with the *Tetilla* acerate; and here we are brought to see the essential difference between the sheaf and the acerate, the former being a fibrillated rod and the latter a concentrically-layered one.

The hamate spicules are found embracing a small round nucleus with a little granular sarcode; but no cell-wall is ever seen (Pl. VII. figs. 4 and 10); so that one is led to conjecture that the spicule may be the cell-wall, especially as it closely resembles in size and appearance the annular cell-wall, to which we have made frequent reference in describing the dermis. The nucleus of the hamate spicules is entirely different in size and character from that of the large spicule-cells and of the geodine globate; it is much smaller, no larger than the nucleolus of the latter, and shows no distinct nucleolus. It is of importance to notice that the hamates are not developed several in one cell, as Carter has asserted of the common tricurvate spicules, as Schmidt has shown for the trichites of *Esperia*, and I, subsequently, for the trichites of *Stelletta Normani*; each hamate has sole possession of its own nucleus; in other words, each hamate cell produces but one hamate spicule. Carter mentions that he has also found two examples of a bihamate occurring singly in its mother cell (A. & M. N. H. 1874, vol. xiv. p. 104, pl. x. fig. 11).

The Embryo.—The segmentation of the ovum has not been observed in any of its stages; but sections of three embryos are shown in very thin slices; they each lie in a brood-chamber lined by a distinct membrane (endothelial) and a thin layer of fibrous tissue. Two, nearly spherical and 0·033 inch in diameter, are still solid throughout; the third (Pl. VII. fig. 1), oval, measuring 0·043 inch along its major and 0·033 inch along its minor axis, is also solid, except for the presence of the subdermal cavities, which are well developed over one

half the circumference, and the flagellated chambers, which are abundantly present in the mark and sometimes seem to be in connexion with the subdermal cavity by a minute incurrent canaliculus. There are otherwise no discernible canals in the mark. The mark is clearly distinguished from the cortical layer of gelatinous connective tissue which represents the non-fibrous layer of the adult cortex. The fibrous layer is at present represented merely by a thin layer of fusiform fibres in a granular gelatinous matrix, developed from the exterior of the mark and appertaining more to it than to the cortical gelatinous tissue; it is entirely unprovided with special spicules. The thick spiculated fibrous layer of the adult cortex is thus comparatively late in developing. No pores are yet visible in the skin, which consists of an external wrinkled membrane, with round nuclei in a layer beneath it (cuticula and ectoderm ?), and a mesodermic layer of gelatinous connective tissue, containing pale oval granular cells dispersed through it. The subdermal cavities are lined by a thin membrane with round nuclei imbedded in it with tolerable regularity: this epithelium may be in continuation with the ectoderm somewhere; but my specimen does not show it. The centre of the mark consists of colourless gelatinous tissue containing irregularly stellate and fusiform cells; but its outer half is granular, as in the adult sponge, and crowded with flagellated chambers; if these are in connexion with a cleavage-cavity, it is curious that there is nothing in my specimen to indicate it. Many *Amœba*-like cells are present in the mark; and in one of them a young acerate spicule is seen almost wholly immersed, as though the latter had developed within it (Pl. VII. fig. 12); and, considering that the cell is almost precisely similar in shape and in the size and character of its nucleus and nucleolus to that in which the *Geodia* globate develops, this suggestion seems not improbable. With regard to the character of its nucleus it also resembles closely the ova of the sponge, but differs in other respects, its outer sarcode being more transparent, less densely finely granular, and staining much more faintly with carmine. Much more close is its resemblance to the *Amœba*-like cells previously mentioned as associated with some of the large spicules of the adult sponge: and on reexamining these I find that the association is much more common than I had before supposed; it appears in all not fully-developed spicules of which I could get a good view, and not only in *Tetilla*, but in *Geodia Barretti* and *Isops Phlegræi* as well; moreover, in a great number of cases I could trace from the heap of sarcode which surrounds the nucleus a thin granular film extending towards

each end of the spicule, up to which, indeed, it completely reaches (Pl. VII. fig. 18). In these cases the spicule-sheath is no other than a single enveloping large cell; and since the spicule increases in thickness by successive onlayerings to its surface, and nothing intervenes between it and the surrounding cell, we are obliged, so it would appear, to regard the latter as the medium through which the spicule increases in size; but the very young spicules appear in a similar cell, which only differs in being smaller and having a correspondingly smaller nucleus and nucleolus, *i. e.* in being younger. Hence it follows that the ensheathing cell is the true parent and nurse of the large spicules with which it is associated; it probably only disappears on the completion of their growth.

The spicules most conspicuously present are the projecting forks, which, with the grapnels with recurved rays and the long fusiform acerates, lie in parallel bundles, radiating not directly at right angles to the surface, but a little obliquely, their inner ends being tangential to an imaginary sphere concentric with the centre of the sponge. The tendency to a spiral arrangement, which Schmidt has well explained as naturally following from the form of the spicules, is thus early declared. Although the points of the forks frequently project through the skin, yet their centre of origin from the shaft always remains beneath or inside it. Most of the fully-developed grapnels (and most of them are fully developed, all three rays being present, although O. Schmidt asserts they do not become complete till the young sponge has left the parent) are completely covered by the skin; but those still incomplete, with only one or two teeth, as figured by Schmidt and Carter, more often protrude for some distance outside it, so that they appear to be in a retarded stage of development in adaptation to some special requirements of the larval state—it may be, for escape from the maternal tissues.

There are no short fusiform acerates, such as occur in the fibrous cortex of the adult; but hamates in their various forms are well represented.

Distribution. Kors Fiord, Norway, Station 13, 200–300 fathoms; Station 16, Station 23, 180 fathoms.

The species is also found about the Shetland Islands in deep water; Iceland, Florida: 152–183 fathoms.

The other described species of the genus are:—

1. *T. antarctica*, Carter, A. & M. N. H. 1872, vol. ix. p. 412, pl. xx. *Loc.* Antarctic Ocean, lat. $74\frac{1}{2}°$ to $77\frac{1}{2}°$ S., long. 175° W.; depth 206–300 fms. Distinguished by absence of hamates.

2. *T. arabica*, Carter, A. & M. N. H. 1869, vol. iv. p. 3, p. i. figs. 1 to 13, pl. ii. figs. 19 and 20. *Loc.* S.E. Arabia.

3. *T. atropurpuroidea*, Carter, A. & M. N. H. 1870, vol. vi. p. 176, pl. xiii. figs. 1–10. *Loc.* Unknown. Distinguished by its large hamates, which are spined, three terminal spines at each end giving them a resemblance to a tridentate anchorate.

4. *T. casula*, Carter, A. & M. N. H. 1871, vol. viii. p. 99, pl. iv. figs. 1–9. *Loc.* Port Elizabeth, Natal, Cape of Good Hope. Distinguished by absence of grapnel-like anchors and general form.

5. *T. dactyloidea*, Carter, A. & M. N. H. 1869, vol. iii. p. 15; 1872, vol. ix. p. 82, pl. x. figs. 1–5. *Loc.* S.E. coast of Arabia.

6. *T. euplocamus*, O. S. Spong. Algier. 1868, p. 40, pl. v. fig. 10. Desterro, Brazil.

7. *T. insidiosa*, O. S. Atl. Spong. Faun. 1870, p. 66, pl. vi. fig. 11. *Loc.* Florida, 17 fms.

8. *T. lens*, O. S. Atl. Spong. Faun. 1870, p. 66, pl. vi. fig. 10. *Loc.* Florida, 135–152 fms.

9. *T. polyura*, O. S. Atl. Spong. Faun. 1870, p. 66, pl. vi. fig. 8. Iceland, 85 fms.

10. *T. radiata*, Selenka, Zeit. f. wiss. Zool. 1880, xxxiii. p. 467, pl. xxvii. *Loc.* Bay of Rio Janeiro, 3 fms.

11. *T. simillima*, Bwk. Proc. Zool. Soc. 1873, p. 15, pl. iii. figs. 6–13. *Loc.* South Seas.

12. *T. tethyoides*, O. S. Atl. Spong. Faun. 1870, p. 66, pl. vi. fig. 9. *Loc.* Florida, 100–123 fms.; Iceland.

13. *T. zetlandica*, Carter, A. & M. N. H. 1872, vol. ix. p. 417, pl. xxii. figs. 1–6, 11–17. *Loc.* Shetland Isles. Distinguished from *T. cranium* by the absence of hamates.

Schmidt's genus *Craniella* is defined as a corticate *Tetilla*, a rind according to Schmidt being absent in the latter genus; but since we have shown its decided presence in *T. cranium*, it becomes highly doubtful whether it is really absent in the remaining species; I have therefore reunited *Craniella* with *Tetilla* under the common name of *Tetilla*.

The absence of hamates from some species of *Tetilla* is probably a case of degeneration similar to that of the loss of trifid spicules in the geodine sponge *Caminus*, or of anchorates from Schmidt's species *Dirrhopalum clopetarium*, with regard to which Mr. S. O. Ridley *, in his exhaustive paper on his genus *Dirrhopalum*, confirms Schmidt's statement as to their absence, though not in the case of *D. gymnazon*, where

* "On the Genus *Plocamia*, Schmidt," by Stuart O. Ridley, Journ. Linn. Soc. vol. xv. p. 476.

he shows that they exist. Vosmaer *, falling into the old snare of classifying from a single character, exclaimed against my placing *D. plenum* along with Schmidt's forms, on the ground that it possesses anchorates, which the latter were not supposed to possess by Schmidt. I have no doubt that, on second thoughts, this able investigator will admit that the assemblage of characters is after all of greater importance than a single one.

Classification.—*Tetilla* is a genuine though somewhat divergent member of the corticate Choristidæ, with close affinities to the Desmacidina; it links together the suborders Tetractinellida and Monaxinellida. The evidence for this statement is found first in its embryological development, next in the characters of the Esperiad *Rhaphidotheca Marshall-Halli*, Kent. In the embryo we find some of its tetractinellid spicules in course of development; they commence with a swelling at the distal end of large uniaxial spicules, from which afterwards teeth are budded off one by one. This is true both for the grapnel- and fork-shaped spicules. Thus the uniaxial clearly precedes the tetractinellid form in development, a fact of signal importance in the discussion as to which originated first, Monaxinellida or Tetractinellida, and in complete correspondence with observations made on the order of development of the spicules in the Calcispongiæ.

In the next place, in *Rhaphidotheca Marshall-Halli* we find the distal ends of some of the large spicules which project from the skeletal fibres beyond the skin distinctly thickened into globular or oval or cylindrical bulbs, in which the axial thread ends in a slight spherical expansion. To suppose that these spicules are parasitic in nature or foreign bodies appropriated by the sponge is an altogether untenable idea, as I shall show when dealing more in detail with this species; they agree in all respects with the other chief spicules of the sponge, except in this one important particular, that they have a dilated or thickened distal end, and thus maintain persistently, though in an exaggerated form, a stage through which the trifid spicules of *Tetilla* very rapidly pass. The rounded swelling of the distal ends of projecting spicules is not confined to *Rhaphidotheca*; I have it in a less marked form in a suberite to which I give the name of *Radiella schœnus* (σχοῖνος, a bullrush).

In the next place, amongst the various forms of small spicules with which *Rhaphidotheca* is richly provided, we find trichite sheaves and C- and S-shaped hamates. The pre-

* 'The Sponges of the Leyden Museum,' by G. C. J. Vosmaer. Family Desmacidinæ, p. 154.

sence of the latter, so characteristic throughout the Desmacidina, would of itself have afforded us a hint as to the alliances of *Tetilla*; but, taken in conjunction with the evidence furnished by the ends of the spicules, it gives us a very strong case indeed. The swollen terminations of the spicules of *R. scharnus* suggest the possibility of a polyphyletic origin for the Tetractinellida. The trichite sheaves of *Rhaphidotheca* deserve a word of mention; for though they are found in several groups of sponges, yet they are most commonly present in Desmacidina and *Stelletta*; and a genetic connexion between these two groups being probable on other grounds, we may regard the sheaves as derived from a common ancestor, and thus gain some hope of tracing out their origin in the other group of sponges in which they occur.

If the *Tetilla* embryo, taken in conjunction with *Rhaphidotheca*, furnishes evidence of a passage from the Monaxinellida to the Tetractinellida, so no less does it show by the late development of its rind a passage from the non-corticate to the corticate sponges, and proves, what we should have predicted on *à priori* grounds, that the latter were preceded by the former. Schmidt's group of Corticata (Rindenschwämme), though heterogeneous as at first constituted, appears to me a good one if restricted to Tetractinellid sponges possessing rinds; and I consequently adopt it so amended in the table which follows below. This appears to be a good place for offering a few observations on the classification of the Tetractinellida. In my paper on the Trimmingham flints I proposed to divide the Tetractinellida into those with loose or separate spicules (Choristidæ) and those with spicules mutually interlocked to form a network (Lithistidæ). Zittel, placing greater stress on the branching character of the latter spicules, had previously declared for a wider separation between the Choristidæ (Tetractinellida) and Lithistids than this would imply; but Oscar Schmidt (rightly, as it seems to me) declares this four-rayed character of the spicules to be fundamental, although he maintains the ordinal distinction of Tetractinellida (my Choristidæ) and the Lithistidæ. The presence in the Lithistidæ of trifid forks and anchors precisely similar to those of the Choristidæ is for me a strong point in favour of their common derivation; and the primary difference lies in the different character of the chief four-rayed elements. In the Choristidæ the chief tetractinellid spicules are confined to the surface (the tetractinellid character is only skin deep); and they are clearly differentiated into shaft and rays, which have a very definite direction with regard to the surface of the sponge, the shaft being usually radial and the rays developed

at its distal end. In the Lithistidæ the distinction into shaft and rays is not strictly maintained, but all four rays have the same value, and start at once from a common centre; moreover they are the chief skeletal spicules, while in many of the Choristidæ the mass of the chief spicules are uniaxial.

Thus, as the Tetractinellid character is the most fundamental, I propose to include all sponges which exhibit it as Tetractinellida; and as the next differentiation would appear to result from the development of quadiradiate body-spicules in Tetractinellids which previously possessed only trifid superficial spicules, I divide the Tetractinellida into Tetractinellida Externa and Completa. The Externa will then fall into Corticata and Non-corticata (Leptochrota, thin-skinned), the Completa into Scolopidæ (sharp-pointed), such as *Dercitus*, and Lithistidæ. The term Choristid may still be conveniently used to designate Tetractinellids in which the spicules are not conjoined into a lithistid network.

The following Table shows the relations between the different Tetractinellida as I conceive them to exist:—

Lithistidæ
|
Scolopidæ——————Completa
|
Corticata
|
TETRACTINELLIDA, Externa——Leptochrota
|
DESMACIDINA.

or

Tetractinellida $\begin{cases}\text{Completa} & \begin{cases}\text{Lithistidæ}\\ \text{Scolopidæ}\end{cases}\\ \text{Externa} & \begin{cases}\text{Corticata}\\ \text{Leptochrota}\end{cases}\end{cases}$ $\left.\begin{matrix}\text{Scolopidæ}\\ \text{Corticata}\\ \text{Leptochrota}\end{matrix}\right\}$ CHORISTIDÆ.

EXPLANATION OF THE PLATES.

PLATE VI.

Pachymatisma Johnstoni.

Fig. 1. Section through the oscular tube (T), separated by the sphincter from the underlying oscular chamber (C): *b*, bacillar layer; *v*, vacuolated connective tissue; *c*, gelatinous connective tissue; *f*, fibrous layer. × 11.

Fig. 2. Section through the sponge, showing the oscular tube (*a*) and the oscular chamber (*b*), with main excurrent canals (*c*) opening into it. Nat. size.

Fig. 3. Section through the commencement of an incurrent tube, showing the poral canals, ectochone, and sphincter. × 15.

Fig. 4. View from above of the poriferous roof: *a*, chone; *p*, pore; *g*, globate spicule. × 23.

Fig. 5. Vacuolated or vesicular connective tissue, with the gelatinous matrix becoming fibrillated. × 315.
Fig. 6. Quadrifid proximal end of a trifid fork.
Fig. 7. A twinned spicule.
Fig. 8. Distal end of a spicule with fork and grapnel-ray.
Fig. 9. Tubercular outgrowths on distal ends of spicules.
Fig. 10. Bacilli: *a–c,* in successive stages of development; *a,* earliest stage; *b,* second stage; *c,* adult spicule; *d* and *e,* varieties with an additional ray.
Fig. 11. Connecting fibres between two globates, showing imbedded granular threads with nuclei. × 640.
Fig. 12. Cells with granules of reserve food. × 315.
Fig. 13. Vacuolated or vesicular tissue at the edge of an ectochone: *g,* globate spicules. × 157.

Plate VII.

Tetilla cranium.

Fig. 1. Section through an embryo still imbedded in the maternal tissues (× 26).
Fig. 2. Section of the upper corner of a subdermal cavity (× 157).
Fig. 3. Section through the entire sponge (nat. size).
Fig. 4. Hamate spicules enclosing nuclei (× 640).
Fig. 5. Ovum with extended pseudopodium-like processes: *y,* yolk-granules. × 157.
Fig. 6. Section through a part of the sponge, showing the structure of the cortex, subdermal cavities, and the oscular tube (*o*) cut across (× 15).
Fig. 7. Poriferous membrane of fig. 15 (× 157). The crossing lines, indicating fibrils, have been too heavily drawn by the engraver.
Fig. 8. Network forming the floor of the oscular tube (× 157).
Fig. 9. A node of the preceding network (× 500).
Fig. 10. A trabecula of the same (× 640).
Fig. 11. Axial thread of one of the fibres of the fibrous connective tissue (× 640).
Fig. 12. Young spicule in its cell from a *Tetilla* embryo (× 640).
Fig. 13. Ectoderm from the interior of a subdermal cavity (× 640).
Fig. 14. Endodermic cells from the walls of a flagellated chamber (× 640).
Fig. 15. External view of the skin, showing pores in poriferous areas (× 52).
Fig. 16. External view of the skin, with its fibrous network showing through; the meshes of the network are not subdivided as in preceding figure, but pores are still present. × 23.
Fig. 17. Spicule-cell surrounding a large chief spicule, drawn on same scale as fig. 12, to show the increase in size of the nucleus and nucleolus (× 640).
Fig. 18. Large spicule completely enclosed in spicule-cell (× 166).

[To be continued.]

XVIII.—*Note on the Species of the Linnean Genus* Asterias *which are ascribed to Retzius.* By F. Jeffrey Bell, M.A.

By the almost universal consent of naturalists, two papers written within the first fifty years of the Linnean zoology are ascribed to one whose name, by his own services and by those of his family, is one of the best known to biologists. On p. 234 of the fourth vol. of the 'Nya Handlingar' of the Kongliga Svenska Vetenskaps-Academien (1783) commences a paper entitled "Anmärkningar vid *Asteriæ* Genus, af A. J. Retzius;" and in its ten pages there are enumerated fifteen species. That this paper is correctly ascribed to Retzius admits of no manner of doubt.

A second paper, dealing with the same subject and entitled a dissertation, appeared more than twenty years later; this paper is ordinarily ascribed to the same author as the paper already spoken of, and allowed to be his.

Is it not, however, somewhat remarkable that a naturalist who was more than sixty years of age and had twenty-two years before dealt with the subject, should be then producing a dissertation (though a dissertation which is indeed of very considerable value, for it enumerates fifty species)? The paper in question is thus quoted by three leading authorities :—

"And. J. Retzius dissertatio sistens species cognitas Asteriarum. Lundæ, 1805, 4" *.

"Retzius, A. J. Dissertatio sistens species cognitas Asteriarum. 1805" †.

"Retzius—Diss. sistens species cognitas Asteriarum. Bruzelius et Lundæ, 1805, 37 pages. Bruzelius in B. H. N. J. p. 560" ‡.

All these three systematic writers are obviously enough referring to the same dissertation, though M. Perrier's citation would be a little difficult to one who would like to see only similar cases united by a conjunction, and who had not at hand the second edition of Engelmann's 'Bibliotheca Zoologica:' here, on p. 351, *s. v.* Retzius, he will find after the title, "resp. Nic. Bruzelius, Lund, 1805 (37 pag.), Bruzelius in B. H. N. I. p. 560 hiernach zu streichen."

Müller and Troschel would seem undoubtedly to have known the work now in question at first hand; they write in their preface, "Die Abhandlung von Retzius Dissertatio

* Müller & Troschel, Syst. der Ast. p. ix.
† Lyman, Ill. Cat. M. C. Z. 1865, p. 9.
‡ Perrier, Rev. de Stellér. Paris, 1875, p. 33.

etc., ist nach Linck die erste systematische Arbeit von Wichtigkeit, und, in Beziehung auf Beschreibung von Arten, eigentlich die einzige ältere von Werth. Sie ist so gut wie völlig unbekannt, von keinem Schriftsteller citirt, und die Citate der Schriften beziehen sich bloss auf seine ältere Abhandlung in den Schriften der schwedischen Academie."

But, now, is this dissertation by Retzius at all? Not, at any rate, so far as the title will allow us to judge. If, instead of copying Müller and Troschel, or consulting a bibliographical work, we go to the original itself, we find the title to be "Dissertatio sistens species cognitas Asteriarum. . . Quam, consentiente Ampliss. Ord. Philos. sub Praesidio D. M. And. J. Retzii [here follow eight lines reciting Retzius's dignities] pro Laurea modeste exhibet *Nicolaus Bruzelius*, Scanus. In Lyceo Carolino die i Junii MDCCCV. Lundæ, Literis Berlingianis."

If we ascribe an essay with such a title to Retzius, then must we give him such other contributions as were "modestly offered" by Planander in his 'Animadversiones in classem Piscium Linneanam," or Danielssen on Entomology, or Jacobson on the Crocodile, all of which were read during his tenure of the presidential chair.

One further proof of the position I take up may be offered from the body of the paper itself. After speaking of earlier writers on the subject, the author says, "Non paucas demum post illum observarunt ac descripserunt O. F. Müller et P. C. Abildgaard in Zoologia Danica et Praeses in novis actis Reg. Academ. Scient. Holmensis editis pro anno 1783." In no other than this connexion is the name or assistance of Retzius referred to.

Had the object of the preceding lines been to bring before the zoological world an essay containing names which would "antedate" those in common use, I should have published them with pain, and I should have suggested whether it would not be advisable here as elsewhere to let the dead bury their dead. But this, I am glad to say, is not the object of these lines; nor have they for any one of their results any alteration of the specific names which have been selected with care and judgment, and with a knowledge of the existence of this dissertation.

In one or two instances it may relieve us of difficulty. The *Ophioderma longicauda* of Müller and Troschel becomes in Mr. Lyman's "Preliminary List" *Ophiura laevis*; this specific appellation is used only by Mr. Lyman, who has taken it from Rondelet (1554); Lamarck called the species *lacertosa*; but as Bruzelius (Diss. p. 28) called it *longicauda*,

we are enabled to retain for this common species the name by which it is best known, and that without any evasion of the rules which have been suggested for the preservation of zoological peace. Dr. Gray and Prof. Perrier are shown to be justified in their adoption of the specific term *Schmideliana* for the *Culcita discoidea* (Lamk.) of Müller and Troschel.

Henceforward, however, those zoologists who add to the specific name the name of its author must bear in mind that Nicolaus Bruzelius claims to share with Retzius in some of the earlier specific titles given to various brachiate Echinoderms.

XIX.—*On some Silurian* Leperditiæ.
By Fr. Schmidt *and* Rupert Jones.

To the Editors of the 'Annals and Magazine of Natural History.'

Gentlemen,

M. Fr. Schmidt, of the Academy of Sciences, St. Petersburg, one of the relatively few palæontologists who have taken up the study of *Leperditiæ* and their allies, has favoured me with the following criticisms on my "Notes on the Palæozoic Bivalved Entomostraca"*, published in the Ann. & Mag. Nat. Hist. ser. 5, vol. viii. Nov. 1881. His long and intimate acquaintance with these Entomostraca in Scandinavia and Russia makes his opinion of great value, especially in the comparison of the English with the North-European species, and of these latter among themselves. M. Schmidt writes thus:—

"1. You regard *Leperditia balthica*† (His.) and *L. Hisingeri*, Schmidt, as varieties or sexual forms; but they belong to different geological horizons, as shown in my memoir‡, and there is a striking specific difference between them in the strong transverse striation on the inverted plate of the left valve of the true *L. balthica*, as shown in your pl. vi. figs. 4 *b*, 5 *b*, Ann. & Mag. Nat. Hist. 1856, and previously noticed by Hisinger and Keyserling. The inverted plate of *L. Hisingeri* is quite smooth. This latter species belongs to the lowest part of the Upper-Silurian series of Gothland—that is,

* These "Notes," marked "XII.," should be "XIII."; and the "Notes" marked "XIII.," in Ann. & Mag. Nat. Hist. September 1879, should be "XII."

† See Ann. & Mag. Nat. Hist. November 1881, p. 334. M. Fr. Schmidt and others adopt the term *baltica*; but I prefer the Linnæan form of the word, as in "*Tellina balthica*."—T. R. J.

‡ Ueber die russischen silur. Leperd. 4to, 1873.

to the 'Wisby group' (so termed by Lindström and myself); and it is very often found near Wisby and in the neighbouring localities on the north-west coast, as well-preserved perfect (bivalve) specimens. *L. balthica* occurs only in the Middle-Gothland stage, and principally on the east coast, near Farö and Slite. It is not rare, but the valves always occur separate.

"In Norway both species are met with on the island of Malmö (I was there in 1875), in the Bay of Christiania; but *L. Hisingeri* is found only on the east coast of that island, in limestones corresponding to the 'Wisby group' of Gothland; whilst *L. balthica* is found on the west coast in strata with *Pentamerus oblongus* (Kjerulf's 'Stage VI.'), corresponding to the Middle-Gothland stage.

"With us, in the Baltic Provinces of Russia, *L. Hisingeri* is found also in the lowest stage of the Upper Silurian (my zone *G*). The form shown in fig. 22 (*L. Hisingeri*, var., Schmidt) of my memoir, there termed a variety of *L. Hisingeri*, belongs to the stage *H* (with *Pentamerus oblongus* or *esthonus*), and may now be better named *L. balthica*, var. *contracta*, Jones, as it seems to be identical with your variety *contracta* (Ann. & Mag. Nat. Hist., Nov. 1881, p. 337); and, moreover, some traces of the transverse striation are visible on the inverted ventral plate of the left valve. The typical *L. balthica* does not occur with us; but it is often met with in the erratic Silurian boulders of Northern Germany.

"2. Another point I have to object to is about *L. grandis*, Schrenck (*L. gigantea*, F. Römer). You believe* that Barrande is right in calling it an *Isochilina*, notwithstanding that in establishing that genus you pointed out that the carapace is *equivalve*, the margins of the valves meeting *uniformly*, and not overlapping as in *Leperditia*. I figured two right valves in my figs. 5 and 6, and two left valves in figs. 3 and 4; and you can see there the inverted plate on the ventral border of the left valve in fig. 3 *a*, and the striking difference beween the two valves when comparing the ventral borders of the left and the right valve in figs. 3 *a* and 5 *a*. The right valve must have been overlapping. The difference in that aspect between our species and other *Leperditiæ* consists merely in the inverted plate of the left valve occupying only a middle part of the ventral border, and not the whole of it. *L. grandis* could thus be, perhaps, the type of a new subgenus, but by no means an *Isochilina*. The external outline of the valves is very constant; and I cannot see any varieties in that respect. Nor can I agree with you in uniting your large specimen from Rupert's Land to our species. Your form

* Ann. & Mag. Nat. Hist. Nov 1881, p. 347.

may be an *Isochilina*, as the margin extends around the ventral border, and there is no inverted plate to be seen; but the valve is highest at the anterior part and not along the ventral border, as I have shown to be the case with *L. grandis*.

"Barrande himself, in describing the left valve of *L. gigantea*, sent to him by F. Römer (Syst. Silur. Bohème, vol. i. suppl. p. 535), says, 'Limbe aplati, relativement large aux deux bouts de la valve et disparaissant presque complètement vers le milieu du contour ventral, sur plus d'un quart de la longueur. Ce limbe est endommagé sur une partie du contour de *Lep. gigantea*, et nous l'avons restauré dans la région médiane:' pl. 34. figs. 4–6. That restoration, however, was not correct. The real form of the ventral border you will find in F. Römer's original woodcut (Zeitschrift d. deutsch. geol. Gesell. 1858, p. 356), exactly corresponding to the specimen which I saw in the Breslau Museum. M. Barrande himself is now entirely of my opinion with regard to the genus of *L. gigantea* or *grandis*.

"3. As to your English specimens of *L. balthica* and *L. Hisingeri*, it would be difficult to identify them with ours, as your *Leperditiæ* apparently are scarce and not well preserved. With us, and in Scandinavia (and, it seems to me, in North America also), the *Leperditiæ* occur abundantly in Upper-Silurian strata, and appear to be very well adapted for characterizing the different stages, as they do not pass from one geological horizon to another, like some Trilobites and Brachiopods. Now let me try to review the *Leperditiæ* from the Baltic Provinces, Scandinavia, and England, described in your last 'Notes,' as far as possible for me to do.

"Your fig. 1, pl. xix., may be the actual *L. balthica* of Hisinger. Figs. 2 and 13 I willingly accept as the types of *L. balthica*, var. *contracta*, Jones. Figs. 3 and 4 are doubtful forms. Fig. 5 [*L. Hisingeri*?] seems very near to, if not identical with, our *L. Keyserlingi* (see my fig. 34), corresponding also in geological position. Fig. 6 [*L. Hisingeri*, var. *gracilenta*, Jones] I would like to regard as intermediate to *L. phaseolus* (His.), as defined by Kolmodin, and my *L. tyraica*, both of which occur in the Uppermost Silurian. Both *L. phaseolus* (*L. Angelini*, Schmidt), with us and in Gothland, and *L. tyraica*, on the Dniester in Galizia and Podolia, have the characteristic angular spot around the eye-tubercle, separated by a narrow space from the central (muscular) spot (see my figs. 11 and 13), and may be regarded as mere local varieties. Your fig. 14 [*L. balthica*, var. *contracta*], from Kamenetz-Podalsk, will be the true *L. tyraica*, as other forms do not exist in that country. I studied the Dniester Silurians, in 1872, at that place; and Prof. Alth of Krakow

agrees entirely with me as to the *Leperditiæ*. Your figs. 15 and 16 I regard as *L. phaseolus*, because the two spots are visible. The locality of Randefer in Oesel belongs to the uppermost (Ludlow) strata of that island; and *L. phaseolus* and *L. grandis* are the only *Leperditiæ* there in that stage. It was my opinion also that *L. phaseolus*, His., is the same as my *L. Angelini*; but I changed the name, as Hisinger had apparently mixed different forms in mentioning *L. phaseolus* as got from Wisby, where *L. Hisingeri* only is met with. Kolmodin, in citing *L. phaseolus* from Wisby, merely follows Hisinger. Its geological position is in the uppermost (Ludlow) strata of Southern and South-eastern Gothland.

"4. I have lately got some new materials of the original '*Cypridina marginata*,' Keyserling*, from the Petchora country. The characteristic margin is visible only on casts, and not on well-preserved specimens. The right valve shows an angular prominence on the ventral border, like your *Leperditia arctica*, but nearer to the posterior end. I will describe the species fully in a supplement to my memoir on the Russian *Leperditiæ*, together with some other forms of that genus."

I. I have to remark that, in accordance with M. Fr. Schmidt's suggestions, *L. balthica* and *L. Hisingeri* are more distinct specifically than I was inclined to consider them. Their collocation with certain Silurian horizons is of great interest; but we must be careful not to limit "species" too strictly to definite strata, in case the distinctions become too artificial.

II. I was wrong to give latitude to *Isochilina* in the development of the ventral margin rather than to *Leperditia* in diminution of that feature. But as the specimen from Rupert's Land is distinct, in M. Schmidt's opinion, from Schrenck's and Römer's species, and is still an *Isochilina*, we can retain the specific name given to it at page 347, but as *I. grandis*, Jones, instead of "*I. grandis* (Schrenck)," Schrenck's species being a *Leperditia* with a slight inversion of the ventral margin.

III. If we follow M. Schmidt's well-founded suggestions, we shall regard my fig. 5 (pl. xix.) as *L. Keyserlingi*, Schmidt; fig. 6 as *L. gracilenta*, Jones; fig. 14 as *L. tyraica*, Schmidt; fig. 16 as *L. phaseolus*; and his own "fig. 22" as *L. balthica*, var. *contracta*, Jones. The other forms in pl. xix. of my "Notes," viz. figs. 3, 4, 7–13, 15, and 17, remain as there named.

Your obedient Servant,

T. Rupert Jones.

* See Ann. & Mag. Nat. Hist. November 1881, p. 347. At line 4 of the page, *for* Upper-Silurian *read* Lower-Silurian.

XX.—*New Genera and Species of* Buprestidæ *and* Heteromera. By Charles O. Waterhouse.

Buprestidæ.

Ptosima Bowringii, n. sp.

Cylindrica, læte cyaneo-violacea, nitida; thorace creberrime evidenter punctato; elytris punctato-striatis, apicem versus fascia sanguinea ornatis.

Long. 4 lin.

Head gently convex, thickly and finely punctured. Thorax very distinctly, not very strongly, very thickly punctured, but the punctures are not crowded; the punctures stronger towards the sides, but the anterior angles are nearly smooth; in the middle of the base there is a short impressed line. Elytra with lines of very distinct punctures; near the suture and at the apex there are impressed striæ; the interstices have each a single line of finer and more distant punctures. A little way from the apex there is a bright red fascia, made by a triangular spot on each elytron uniting with the other at the suture.

Hab. China (*J. C. Bowring, Esq.*). Brit. Mus.

Ptosima apicata, n. sp.

Subcylindrica, dorso depressiusculo, sat nitida, olivaceo-ænea; fronte purpurascente, parum concava, crebre sat fortiter punctata, vertice subtilius punctulata, guttis duabus flavis ornata; thorace creberrime punctato, antice convexo, basi media paulo producta, minus crebre punctata, linea brevi impressa, lateribus maculis duabus flavis; elytris striatis, striis crebre punctatis, interstitiis uniseriatim minus crebre punctatis, maculis sex flavis ornatis, apice dentato.

Long. 6 lin.

Resembles *P. amabilis*, L. & G., in general form and appearance, and agrees with it in having the apex of each elytron tridentate. It differs in having the forehead slightly concave. The thorax is longer, and more angularly produced in the middle of the base; the sides are slightly angular in front of the middle; and the posterior angles are not turned in; there is a small yellow spot on the anterior angle, and a much larger one near the hind angle. The scutellum is more elongate triangular. The scutellar region of the elytra is impressed; the striæ are more distinct and the punctures on the interstices are as strong as those in the striæ; the suture at the apex is finely and more thickly punctured. There is an oblique yellow spot over each shoulder, a transverse one

about the middle, touching the margin but not reaching the suture, and a third some distance from the apex. The underside of the body is more bluish. There is a yellow spot on the posterior coxa, and on the side of the first, second, and fifth segments of the abdomen. The prosternum is closely and very strongly punctured. The metasternum is less strongly and less closely punctured. The basal segment of the abdomen is thickly and strongly punctured, the second segment not quite so strongly, and the third, fourth, and fifth less closely and less strongly punctured in the middle.

Hab. India? Brit. Mus.

Ancylotela, n. gen.

General character of *Ptosima*, but less cylindrical, more pear-shaped. The thorax is subglobose, very convex, at the middle considerably broader than the elytra; at the base there is a slight constriction. Elytra at the base the same width as the base of the thorax, but with the shoulders a trifle wider; very flat on the back, impressed at the scutellum, gently narrowed posteriorly, arcuately acuminate at the apex; there is a strong acute tooth on the margin a little way from the apex, with a stronger one above it; at the suture there is a sharp ridge, which terminates in a strong tooth just above the apex; the apex itself is truncate and has four very short teeth. The abdomen has the second segment distinctly angularly produced in the middle; the third segment is very slightly so; the third and fourth segments have their apical angle very prominent, almost dentiform.

The general form of this insect, combined with the curious armature of the elytra and the structure of the abdomen, necessitate the formation of a genus for its reception. It should be placed next to *Tyndaris*.

Ancylotela oculata, n. sp.

Subpyriformis, ænea, nitida; thorace subgloboso, creberrime transversim aciculato-punctato, antice linea longitudinali impresso, basi media angulata fovea impressa, ad angulos anticos macula flava magna medio puncto nigro; elytris striatis, striis confertim punctulatis, interstitiis dorsalibus planis, parce punctulatis, lateralibus convexiusculis fortius punctatis, paulo pone medium macula laterali flava.

Long. $5\frac{1}{4}$ lin.

Hab. Chili. Brit. Mus.

Heteromera.

Tenebrionidæ.

Homœogenus, n. gen.

General form elongate ovate, very convex. Third joint of the antennæ as long as the first and second taken together; the sixth to eleventh broad, flat, and opaque. Prosternum prolonged posteriorly into a deflexed acuminate process. Mesosternum deeply excavated to receive the prosternal process; the sides of the excavation raised, but not angular (as they are in *Amenophis*). Epipleural fold of the elytra broad at the base, gradually narrowed to near the apex, where it suddenly vanishes. Legs rather long, the femora linear; the posterior tibiæ cylindrical, not channelled. Thorax transverse, rather flat, deeply emarginate in front, all the margins very narrowly incrassate, the anterior angles very prominent.

This genus may be placed near *Taraxides*, Waterh. (= *Nyctobates sinuatus*, see Ann. & Mag. Nat. Hist. 1876, xvii. pp. 288, 289); but it differs from that and all the allied genera in the form of the thorax. The convex elytra most nearly resemble those in *Amenophis*, Th. (Arch. Ent. ii. p. 93); but the posterior tibiæ are not channelled as in that genus, and the mesosternal excavation has not the sides angular.

Homœogenus laticorne, n. sp.

Nigrum, convexum, parum nitidum; thorace sat planato, crebre subtiliter punctulato, transverso, antice profunde emarginato, angulis anticis sat latis, obtusis, lateribus sinuatis, basi utrinque sinuata; elytris bene convexis; thorace multo latioribus, quintuplo longioribus, ad apicem arcuatim acuminatis, fortiter striatis, striis fere impunctatis, interstitiis dorsalibus vix convexis, parum nitidis, lateralibus sat convexis opacis, corpore subtus pedibusque sat nitidis.

Long. 16 lin.

The head is densely and very finely punctured; the epistoma is rather less densely so, and is lightly impressed on each side. The five basal joints of the antennæ are smooth and shining, the following joints broad; the seventh and eighth are a little broader than long, the inner apical angle more acute than the outer one. The striæ of the elytra at first sight appear impunctate; but on close examination they are seen to be finely punctured; the interstices are coriaceous and finely and irregularly scratched.

Hab. Sumatra. Brit. Mus.

Amarygminæ.

Eulytus, n. gen.

General characters of *Eupezus*, but with the eyes smaller and widely separated above. Thorax transversely quadrate, with the anterior angles slightly prominent, and the base simply and gently arcuate. Elytra at the base the same width as the thorax; the disk of each elytron with a double sublateral inflation; the apex declivous and acuminate. Mesosternum with the anterior angles made by the excavation more prominent. Metasternum very short, in the middle not quite so long as the basal segment of the abdomen; parapleura narrow posteriorly, with the inner margin flexuous. Intercoxal process of the abdomen very broad and very obtusely rounded; the apical segment with a well-marked impression at the apex (♀?). Antennæ and legs as in *Eupezus*.

Eulytus nodipennis, n. sp.

Niger, nitidus; thorace subtilissime crebre punctulato; elytris striatis, striis interruptis punctis impressis, discis inflatis.

Long. 8 lin.

Head very thickly punctured; there are two small impressions between the eyes, and a third on the vertex. Thorax shining, one third broader than long, gently convex, margined in front and at the sides, very delicately and thickly punctured; the anterior angles moderately prominent and acute; the sides subparallel to near the front, where they converge. Scutellum strongly transverse and finely punctured. Elytra with all the discoidal portion raised above the level of the thorax, strongly declivous and acuminate at the apex. The striæ are well marked, but are interrupted, and have numerous elongate impressions. The disk of each elytron is inflated laterally; and this inflation is transversely impressed in the middle, so that it is divided into two, the fifth and sixth striæ uniting between them; the interstices are excessively finely punctured. The legs are thickly punctured. The antennæ are thickly punctured, the four apical joints opaque.

Hab. East Africa.

Of this very remarkable species I have only seen a single example in Colonel Shelley's collection.

XXI.—*Notices of British Fungi.* By the Rev. M. J. Berkeley, F.R.S., and C. E. Broome, Esq., F.L.S.

[Continued from ser. 5, vol. vii. p. 131.]

**Agaricus* (Lepiota) *cristatus.*

A beautiful form occurred in a fern-case at Blackheath, exactly according with Krombholz's t. 25. f. 26–30. It had not the strong smell of the ordinary form.

1927. *A.* (Tricholoma) *Schumacheri*, Fr. Hym. Eur. p. 69; Fl. Dan. t. 2267. fig. 1.

In a hothouse, Apethorpe, Norths. Found once only; agreeing very closely with the figure in Fl. Dan., especially as regards the gills.

1928. *A.* (Tricholoma) *porphyroleucus*, Fr. Hym. Eur. p. 75.

Coed Coch, Oct. 1881. The long-stemmed form.

1929. *A.* (Clitocybe) *incilis*, Fr. Hym. Eur. p. 94.

Shrewsbury, W. Phillips.

**A.* (Clitocybe) *obsoletus*, Batsch, fig. 103.

Hothorpe, Norths., Nov. 23, 1881, Miss R. Berkeley.

Just the plant of Batsch, but the odour varying from that of bitter almonds to that of aniseed. The term *obsoletus* used by Batsch does not refer to an odour less than that of *A. fragrans*, but to the pallid tint as compared with his *A. obsolescens.*

**A.* (Mycena) *cohærens*, A. & S. p. 163.

Coed Coch. Amongst pine-leaves in great perfection. It has much affinity with *A. balaninus*, B.; but that has the margin of the gills purple. They have, however, the same fulvous bristles on the surface.

1930. *A.* (Mycena) *excisus*, Lasch, in Linn. viii. no. 538.

Hothorpe, Norths., Miss Ruth Berkeley.

Magnificent specimens of this species occurred Nov. 17, 1881, in the above locality. Pileus 3 inches across, stem 4 inches high, root 2 inches long. The specimens were either solitary or subcæspitose; gills purplish, strongly cut out behind. The fig. Bull. t. 518 1 is more characteristic of the specimens than that in Fries's 'Icones,' taken from smaller and probably more superficial individuals.

**A.* (Omphalia) *buccinalis*, Sow. t. 107.

This is certainly no form of *A. umbelliferus*; and it is too fleshy to be the same as *A. stellatus.* It is, as Sowerby says, not uncommon, and is in great perfection this Jan. 8, 1882.

It has the habit of *A. ptychophyllus*, Cd., a species not noticed by Fries; but the gills are not plicate.

1931. *A.* (Omphalia) † *directus*, B. & Br. Albus, gracillimus, pileo gomphiformi apice plano, stipite ascendente versus basin pilis longis vestito; lamellis longe decurrentibus.

On dead leaves, Chiselhurst, Nov. 1865. Stem slightly rufous, thread-like, not an inch high. The same species was sent by G. W. Smith, May 4, 1870.

1932. *A.* (Pleurotus) *pantoleucus*, Fr. Ic. t. 88. fig. 2.

Blown out of a tree at Coed Coch during the great gale of Oct. 14, 1881. Exactly the plant of Fries, of which a drawing was originally sent from Sweden under the name of *A. spodoleucus*, Ic. t. 87. fig. 1.

1933. *A.* (Pleurotus) *revolutus*, Kickx, p. 158.

On a poplar tree, Penzance, T. Pengelly. J. Ralfs (no. 367).

A magnificent Agaric, clearly that of Kickx, but considered by Fries a form of *A. salignus.* It is clearly the same with *A. corticatus*, Saund. & Sm. t. 4. fig. 2. The stem is short, but distinct and swollen.

1934. *A.* (Pleurotus) *limpidus*, Fr. Ic. t. 88. fig. 3.

Penzance, J. Ralfs.

1935. *A.* (Entoloma) *lividus*, Fr. Hym. Eur. p. 189.

East Dereham, Norfolk, the Rev. J. M. Du Port.

1936. *A.* (Entoloma) *Batschianus*, Fr. Hym. Eur. p. 191.

Coed Coch, Oct. 1881, Miss Ruth Berkeley. Spores rather irregular, ·0003 inch in diameter.

1937. *A.* (Entoloma) *bulbigenus*, B. & Br.; *A. Persoonianus*, Phill. Gard. Chron. 1881, p. 874; *A. sericeus*, Pers. Ic. et Descr. t. 6. f. 2.

East Dereham, Rev. J. M. Du Port. Sibbertoft, Norths., Feb. 1882, Miss Ruth Berkeley. Just the plant of Persoon, who indicates in his figure the sclerotioid bodies at the base, though he does not mention them in the text. The name of *A. Persoonianus* requires to be changed, as there is a species of similar name. Fr. Hym. Eur. p. 25. Spores ·0004 to ·0005 inch in diameter.

1938. *A.* (Entoloma) *speculum*, Fr. Hym. Eur. p. 197.

Coed Coch, Oct. 1881. Spores irregular, ·0005 inch in diameter.

1939. *A.* (Pholiota) *verruculosus*, Lasch, Fr. Hym. Eur. p. 221.

King's Cliffe. A subspecies, according to Fries, of *A. squarrosus.*

**A.* (Pholiota) *caperatus*, P. Syn. p. 293.

Var. *macropus*, Fr. Hym. Eur. p. 215.

King's Cliffe.

† Non tuba *directi*, non æris cornua flexi.—Ov. *Met.*

1940. *A.* (Pholiota) *dissimulans*, B. & Br. Pileo primum erebio, campanulato obtusissimo vix viscidulo hygrophano demum explanato albido, margine involuto; stipite deorsum incrassato candido, basi gossypino; annulo erecto ut plurimum persistente; lamellis pallidis argillaceis sinuato-adnatis demum decurrentibus.

On sticks of hawthorn and sloe. Hothorpe, Miss R. Berkeley.

Pileus at first of the colour of *A. erebius*, but at length becoming pale and expanded, about 1 inch across. Stem fistulose, with transverse dissepiments. Gills at length decurrent. It ought perhaps to be recorded in the section *Tubaria*, which, however, is a purely artificial division, and the ring is against this. It must be placed at the head of the hygrophanous *Pholiotæ*, though it is not allied to the species in that division.

**A.* (Inocybe) *Bongardi*, Fr. Myc. Eur. p. 229.

Coed Coch, 1881. Spores bulging on one side, as in *Eunotia*, ·0005 inch long.

**A.* (Inocybe) *flocculosus*, B. Eng. Fl. v. p. 97.

Coed Coch, Oct. 1881. Spores irregular, ·0003 inch in diameter, sometimes slightly elongated.

**A.* (Inocybe) *scabellus*, Fr.

Hothorpe, Miss R. Berkeley, Nov. 23, 1881, with *A. scaber*.

This does not seem to be a common species; but we were glad to get it again, as it enables us to ascertain that it has granulated spores, like *A. fastigiatus*.

1941. *A.* (Inocybe) *cæsariatus*, Fr. Hym. Eur. p. 234.

Coed Coch, Oct. 1881. Spores even, ·0004 long.

1941 *bis*. *A.* (Hebeloma) *senescens*, Batsch, fig. 197.

Amongst fir trees, Gwrwch Castle, exactly resembling the figure of Batsch, which does not seem to have been noticed by Fries.

Pileo e convexo explanato leviter glutinoso ochraceo-fulvo, extremo margine subtiliter tomentoso albo; stipite primum deorsum bulboso fusco, dein, excepto apice candido tomentoso, squamuloso, solido; lamellis confertis primum pallidis adnexis, dein cinnamomeis; carne alba, odore acri.

Sometimes semiglobose; stem 5 inches high, always dark below; pileus 3 inches or more in diameter.

1942. *A.* (Hebeloma) *subcollariatus*, B. & Br. Pileo convexo subcarnoso pallido centro subfusco leviter glutinoso, velo flocoso evanescente; stipite farcto demum subtiliter fistuloso basi brunneo pulverulento; lamellis ventricosis secedentibus collarium breve interruptum formantibus argillaceis acie candidis.

On naked soil, Sibbertoft, Oct. 1881; about an inch in diameter. Allied to *A. mesophæus*, of which we were at first inclined to consider it a variety. Spores elliptic, uninucleate, ·0005 inch long.

**A.* (Hebeloma) *firmus*, P. Ic. et Desc. tab. 5. figs. 3, 4.

This appears to be a very variable species. The figure in the 'Icones' does not accord in several respects with the characters in Hym. Eur. The pileus is neither campanulate nor umbonate, but at length depressed. An Agaric, certainly referable to this species, occurred at Hothorpe, Norths., Feb. 8, 1882, in which, though the essential characters are the same, the pileus is at first of a deep brown, but hygrophanous, changing to tan-colour. The stem obviously though minutely scaly; the gills adnate with a minute decurrent tooth, at first pale, then argillaceous, their margin distinctly edged with snow-white particles.

1943. *A.* (Flammula) *vinosus*, Bull. t. 54.

Abundant on the Morfa, Conway, Miss R. Berkeley. A very interesting species which has scarcely been gathered since the time of Bulliard. Spores pale umber, ·0002 inch long, shortly ovate.

1944. *A.* (Flammula) *astragalinus*, Fr. Hym. Eur. p. 248.

Sent from Glamis by the Rev. J. Stevenson, in whose specimens the flesh was intensely red, and when bruised, as described by Fries, became black. Perhaps the most beautiful of Agarics.

1945. *A.* (Flammula) *apicreus*, Fr. Hym. Eur. p. 249.

Coed Coch, 1881. Very acrid.

1945 *bis*. *A.* (Naucoria) *lugubris*, Fr. Hym. Eur. p. 253.

Coed Coch. A single specimen only, in a mountain-fir wood.

Spores very irregular, ·0002 to ·0003 inch long, subglobose.

1946. *A.* (Naucoria) *melinoides*, Fr. non Bull., excepta 560. fig. 1 F, the other figures belonging to *A. hypnorum*.

Kew, Dr. Cooke. Spores elliptic, ·0006 inch long, with one or two nuclei.

1947. *A.* (Naucoria) *sideroides*, Bull. t. 588.

Amongst moss, Sibbertoft, Nov. 10, 1881. Spores ·0004 to ·0005 inch long, half as much wide. This and the two neighbouring species, though externally resembling each other, have very different spores.

1948. *A.* (Naucoria) *cerodes*, Fr. Hym. Eur. p. 257.

Amongst moss, Sibbertoft, Sept. 23, 1881. Spores ·0003 inch long.

1949. *A.* (Crepidotus) *epigæus*, Pers. Syn. p. 377; *A. depluens*, Batsch, fig. 122.

On the clay of the marlstone, Hothorpe, Nov. 10, 1881, Miss Ruth Berkeley. The spores of this species are oblong, ·0004 inch long, not irregular, and more or less angular, as in the plant usually referred to *A. depluens*, as figured by Hoffmann; so that its affinities seem rather to be with *Crepidotus* than *Claudopus*.

The present is exactly the plant of Batsch; and we think it better to leave the name with what has formerly been considered his species, and retain that of Persoon. *A. depluens* occurred in 1881, on sawdust, at Coed Coch, just as it is figured by Hoffmann. It has sometimes a distinct stem, as we have ourselves found it. The gills in *A. epigæus* are no longer red when dry.

1950. *A.* (Hypholoma) *lacrymabundus*, Fr. Ic. 134. fig. 1.

The species figured in the 'Icones' occurred last October at Coed Coch and near Hereford. What has usually passed under this name is *A. velutinus*, P. We find the spores ·0003–·0004 inch long, in *A. pyrrhotrichus* ·0005–·0006.

**A.* (Hypholoma) *cascus*, Fr. Hym. Eur. p. 294. What we described in the "Notices" as an abnormal state of *A. appendiculatus* is undoubtedly this species.

1951. *A.* (Hypholoma) *pilulæformis*, Bull. t. 112.

Penzance, Mr. Ralfs. This is possibly a veil-bearing state of the very common *A. spadiceus*, though Fries says "velum etiam primitus absolute nullum." We are inclined rather to consider it the young of *A. hydrophilus*, Bull. t. 511; still we think it right to record its occurrence in Cornwall. We do not suppose with Fries that it has any thing to do with *Bolbitius*.

1952. *A.* (Psilocybe) *hebes*, Fr. Hym. Eur. p. 303.

On grass by the side of a chestnut-plantation amongst dead leaves. Hothorpe, Miss R. Berkeley, Nov. 19, 1881.

Not exactly the form figured by Fries in the 'Icones,' as the stem is taller; but the colour of the hygrophanous pileus is the same exactly, the spores atropurpureous. Pileus at first obtuse; but in drying it becomes spuriously and minutely umbonate. Spores ·0007 inch long.

**A.* (Psathyra) *corrugis*, P. Syn. p. 424.

Shanklin. The short form figured by Corda in Sturm's Deutschl. Fl. under the name of *A. vinosus*.

1953. *A.* (Psathyra) *gossypinus*, Bull. t. 425. fig. 2.

Coed Coch, Oct. 1881. Spores ·0004 to ·0005 long.

1954. *A.* (Psathyra) *nolitangere*, Fr. Hym. Eur. p. 309.

Amongst moss. Sibbertoft, Sept. 3, 1881. Spores ·00055 long, more elongated than in *A. gossypinus*. *A. pennatus*, Quélet, = *A. semivestitus*, B. & Br.

1955. *A.* (Psathyra) *microrhizus*, Lasch, no. 468.

On the naked soil. Sibbertoft, Sept. 3, 1881. Gregarious, varying in size from a few lines to $1\frac{1}{4}$ inch, when it approaches the finer forms of *A. gossypinus*.

1956. *A.* (Psathyrella) *trepidus*, Fr. Syst. i. p. 238.

Hothorpe, Miss R. Berkeley. Pers. Myc. Eur. t. 29. fig. 1 is an excellent figure of this species.

**Coprinus aratus*, B. Outl. p. 176.

A group of this fine species of large size occurred at Hothorpe, Dec. 5, 1881.

As the character given before was drawn up from a solitary specimen gathered in a very different situation, it requires a little amendment. The disk is sometimes rugose, sometimes even; the gills are at first attached, but so slightly that they easily part from the stem, so as to appear free; but they are still connected at the base, as if there were a slight collar. For "lamellis liberis," "lamellis secedentibus" should be substistuted.

1957. *C. alternatus*, Fr. Hym. Eur. p. 327; Fl. Dan. 1961. fig. 1.

East Dereham, Rev. M. Du Port, at the same time with *A. lividus*.

This is scarcely a *Coprinus*, but rather a *Psathyrella*.

1958. *C. papillatus*, Fr. Hym. Eur. p. 326.

Shrewsbury, P. M. Berkeley. In a fern-case.

1959. *Cortinarius* (Phlegmacium) *serarius*, Fr. Hym. Eur. p. 350.

Glamis, Rev. J. Stevenson. A small form.

1960. *C.* (Dermocybe) *cotoneus*, Fr. Hym. Eur. p. 372.

Clifton, C. Bucknall.

1961. *Paxillus Fagi*, B. & Br. Eximie gregarius, crispus, sursum pallidus, subtus aurantius, lamellis crispatis aurantiis.

On a beech-stump. Coed Coch. Forming a wide crisped mass of great beauty, very different in appearance from *P. panuoides*, which is confined to fir wood or sawdust.

1962. *Hygrophorus fusco-albus*, Fr. Hym. Eur. p. 410.

Amongst moss. Gwrwch, 1881. Remarkable for its distinct floccose veil.

**Marasmius Wynnei*, B. & Br.

A good figure of this beautiful species is given in 'Fungi Tridentini' by Bresadola under the name of *Clitocybe xanthophylla*.

**M. scorteus*, Fr. Hym. Eur. p. 468.

Penzance, J. Ralfs.

1963. *Polyporus Michelii*, Fr. Hym. Eur. p. 533.

Penzance, J. Ralfs.

1964. *P. acanthoides*, Fr. Hym. Eur. p. 540.

Penzance, J. Ralfs.

1965. *P. pectinatus*, Kl. in Linn. viii. p. 485; Fr. Hym. Eur. p. 559.

Penzance, J. Ralfs. We follow Fries, though with some hesitation, in considering the European forms figured by Quélet identical with the Indian species. It cannot, however, be referred either to *P. salicinus* or *P. conchatus*.

1966. *P. velutinus*, Fr. Syst. i. p. 368.

Penzance, J. Ralfs, who has also sent *P. hirsutus*.

1967. *P. mucidus*, Fr. Hym. Eur. p. 577.

Penzance, J. Ralfs. On the under surface of very decayed firs.

1968. *Dædalea cinerea*, Fr. Syst. i. p. 336.

Penzance, J. Ralfs.

The thick substance separates this from every form of *D. unicolor*, also the inciso-strigose surface of the pileus.

1969. *Hydnum Weinmanni*, Fr. Hym. Eur. p. 613.

Penzance, J. Ralfs.

1970. *H. aureum*, Fr. Hym. Eur. p. 613.

Penzance, J. Ralfs. A fine species, with a merulioid aspect.

1971. *H. denticulatum*, P. Myc. Eur. ii. p. 181.

Penzance, J. Ralfs.

1972. *Irpex carneus*, Fr. Hym. Eur. p. 622.

Penzance, J. Ralfs. When perfect it is a true *Irpex*.

1973. *Phlebia lirellosa* (P.), *Dædalea lirellosa*, P. Myc. Eur. iii. p. 2, tab. xvii. figs. 2, 3.

Penzance, J. Ralfs. This is not noticed by Fries in Hym. Eur.; but it is very distinct.

**Stereum vorticosum*, Fr. Hym. Eur. p. 639.

Noble specimens of this very beautiful species, remarkable for its costate hymenium, were sent from Penzance by Mr. Ralfs, who is in a position in Cornwall to send many more novelties.

1974. *Corticium umbrinum*, A. & S. p. 281.

Penzance, J. Ralfs; Hothorpe, Feb. 1882.

1975. *C. maculæforme*, Fr. Hym. Eur. p. 656.

Penzance, J. Ralfs.

**Sparassis crispa*, Fr. Syst. i. p. 465.

Penzance, J. Ralfs.

This seems to be a southern species, not having occurred in this country north of Norfolk.

1976. *Clavaria pyxidata*, P. Comm. t. i. fig. 1.

Penzance, J. Ralfs.

1977. *Calocera corticalis*, Fr. Hym. Eur. p. 681; Batsch, fig. 162.

Penzance, J. Ralfs.

1978. *Penicillium macrosporum*, B. & Br. Aurantiacum, sporis globosis maximis.

On a decaying *Lactarius*, J. D. C. Sowerby, whose drawing is in the collection of the British Museum.

1979. *Cercaspora Bloxami*, B. & Br. Maculis orbicularibus pallidis; sporis elongato-fusiformibus utrinque acuminatis multiseptatis.

On decaying leaves of turnips. Twycross, Rev. A. Bloxam. Formerly distributed as *Septoria Bloxami*.

1980. *Ovularia elliptica*, B. & Br. Gard. Chron. 1881, ii. p. 340 cum icone.

On various lilies. Spores ·0012 long.

1981. *O. syringæ*, B. Gard. Chron. 1881, ii. p. 665 cum icone.

On leaves of *Syringa*, Aberdeenshire, A. Stephen Wilson.

1982. *Mystrosporium alliorum*, B. Gard. Chron. 1878.

On onions. Culver, Exeter.

1983. *Puccinia oxyriæ*, Buch. White, MSS.

On leaves of *Oxyria reniformis*. Ben Blabhein, Skye, Dr. Buchanan White, Sept. 1881. Spores, including the short hyaline stem, ·0024 inch long; the divisions of the head subglobose, even.

1984. *Glœosporium Lindemuthianum*, Saccardo, Fung. It. 1032.

On pods of *Phaseolus*. Very destructive at Sibbertoft in 1881.

1985. *Leotia chlorocephala*, Schwein. Syn. p. 88.

Hampshire, Miss Broadwood. The tint of green is so dark that it is nearly black, so that the house-painters might call it invisible green. *L. atrovirens*, P., occurred at Coed Coch in Sept. 1881; but it is clearly merely a state of *Geoglossum viride*, which accompanied it. The specimens agreed in every respect with the figure in Myc. Eur. t. 9. figs. 1–3.

1986. *Sphæria leprosa*, P.

Penzance, J. Ralfs. Spores ·0008 inch long, narrow.

**Valsa cratægi*, Currey.

On dead twigs. Spores ·0012 long.

1987. *Sphæria aggregata*, Lasch in Kl. Herb. Myc. ii. no. 541; Fuckel, no. 977.

On *Euphrasia officinalis*. Penzance, J. Ralfs.

1988. *Didymium effusum* (Lk.).

On fronds of hart's tongue. W. G. Smith.

XXII.—*Contributions to the Knowledge of the Alcyonaria, with Descriptions of new Species from the Indian Ocean and the Bay of Bengal.* By Stuart O. Ridley, M.A., F.L.S., Assistant in the Zoological Department, British Museum.

Of the new species which form the chief feature of this paper two were recently obtained by a collector at Mauritius, Mr. V. de Robillard, and purchased of him by the Trustees of the British Museum, and, from their novel structural characters and remarkable size and beauty, give great promise of important results to be obtained whenever this little-known branch of the fauna of Mauritius is more fully investigated. Extraordinarily fine specimens of the beautiful *Calligorgia* (*Primnoa*) *plumatilis*, M. Edw. & Haime, and the Hydrozoan *Stylaster flabelliformis*, were obtained from the same source.

Notes are added on some of the genera of Gorgoniidæ established, mainly on external characters, by Dr. Gray; the types are in the British Museum, and have now been submitted to microscopic examination. The results appear sufficiently important to be worth recording, as many of these genera can hardly be said to be known to science, owing to the ignorance in which the descriptions leave us as to their more minute characteristics.

The measurements of spicules given below represent the *average maximum* sizes of the spicules and are inclusive of tubercles.

Alcyoninæ, Kölliker.

Nephthya, Audouin.

Nephthea, Audouin, Expl. pl. Descr. Egypte, i. p. 230.

The only described species which can be admitted in this genus, as distinguished from *Ammothea* by the large size of its cortical spicules, from *Eunephthya* by their not projecting from the surface of the cœnenchyma, and from *Spongodes* by the polype-spicules not projecting beyond the retracted polype, are:—

N. Chabrolii, Audouin (incl. *innominata*, Sav.), Expl. pl. Descr. Egypte, *l. c.* Red Sea.

N. (*Alcyonium*, Q. & G.) *aurantiaca*, Quoy & Gaimard, Voy. Astrolabe, p. 277, pl. xxii. figs. 16–18. New Zealand.

N. coccinea, Stimpson, Proc. Acad. Philadelphia, vii. p. 375. China.

N. aurantiaca, Verrill, Proc. Ess. Inst. iv. p. 191. China Sea, 23° N. lat.

N. nigra, Pourtalès, Bull. Mus. Comp. Zool. i. p. 130. Sand Key, Florida.

Other species have been assigned to it, but transferred to other genera (e. g. *Eunephthya*, Verrill, *op. cit.* vi. p. 80, and *Spongodes*, Klunzinger, Kor. Roth. Meer. p. 38).

A new species is now added :—

Nephthya burmaensis, n. sp.

Base spreading, lamellar, coriaceous; vertical portion consisting of short (the "primary") lobes, about 10 millim. in diameter, which themselves divide almost immediately into the ultimate polype-bearing lobules (or secondary lobes), which are slender, viz. only about 3 millim. in diameter, and so numerous as to conceal most of the lobes and the common base. A few single polypes are also borne directly on the primary lobes. The lobules or secondary lobes are thickly covered with the large polype-cells, whose bases occupy almost the whole of the surface of the lobule. The polype-cells project outwards almost at right angles to the lobule, with a slight upward direction; they are prominent cylindrical bodies, measuring 2·5 millim. in length by 1·25 millim. in diameter, and terminate (in the closed condition) in a rounded end, on which the eight segments of the contained polype are indicated by the presence of eight distinct pairs of smallish spicules, whose distal points form a circle round the orifice of invagination, the spicules themselves lying in the direction of the long axis of the polype.

The two spicules forming each of these terminal pairs are generally parallel and in close juxtaposition with each other, but sometimes diverge proximally, forming a V. A collar of closely appressed spicules lies at the base of this crown, the long axes of the spicules being at right angles to those of the latter. The succeeding spicules as far as the base are irregularly arranged, with distinct gaps between them, more or less across the long axis of the lobes or lobules; those of the base are closely aggregated and mostly parallel to each other. Spicules white in spirit, of one type throughout, viz. curved, fusiform, pointed at ends, thickly covered with prominent blunt tubercles, themselves covered with small tubercles; the tubercles sometimes approach a verticillate arrangement in the larger spicules. The spicules (i.) of the crown are elongated and somewhat sharply pointed, those (ii.) of the base rather thick in the middle, tapering rapidly to

the rather sharp point; those (iii.) of the intermediate area are long, blunter, and more uniform in diameter throughout the spicule. Size of spicules (i.) of crown about 1 by ·1 millim., (ii.) of base ·5 by ·1 to 1·4 by ·28 millim., (iii.) the largest of intermediate area 2 by ·2 millim.; but there is a gradation in size from the intermediate area to the crown on the one hand, and to the base on the other.

Colour of soft parts very pale flesh-colour.

Hab. British Burmah (coll. Mus. Brit.).

Examined. In spirit.

Obs. The species is represented by a small colony of three primary lobes rising from the common base, which clasps a small calcareous mass; maximum height 25 millim., maximum width 45 millim. It was presented to the national collection by W. Theobald, Esq., in company with some Crustacea.

From all the species assigned above to the genus either the pale colour of the soft parts or the whiteness of the spicules distinguishes it; *N. Chabrolii*, which seems to have the dull general coloration, differs in its very large polypes and their green spicules. *N. niger* is, of course, black; and if the "costæ" assigned to it are ridges resembling the costæ of Madreporaria, they constitute another point of difference; but I am not sure what is intended by the term.

Morchellana, Gray.

Morchellana, Gray, P. Z. S. 1862, p. 30.

Having examined the type specimen of the species on which this genus is based (viz. *M. spinulosa*, Gray, *l. c.*, figured), I cannot see sufficient reason for its generic distinction from *Spongodes*, with which it agrees in having a large spicule projecting longitudinally at the side of the polype-cell. The wall of the stem is thin, and contains small fusiform spicules. The brittleness mentioned by Dr. Gray appears to be due to the impregnation of the specimen by salt previous to its immersion in spirit and the perhaps consequent alteration of the consistency of the spicules, which shows itself in their unusual brittleness and opacity. The same fact accounts in part for the infrequency with which the projection of the polype-spicule can be made out, owing to its fracture in many cases.

Primnoaceæ.

Villogorgia, Duchassaing de Fonbressin & Michelotti.

Villogorgia, Duch. de Fonbressin & Michelotti, Mém. Cor. Antilles, p. 32.
Paramuricea, Kölliker (pars), Icones Histiol. p. 136; Studer, MB. Ak. Berlin, 1878, p. 653.
Lissogorgia, Verrill, Proc. Bost. Soc. 1864, p. 213.
?*Blepharogorgia*, Duch. & Mich. Rev. Spong. Zooph. Antilles, p. 15.
Boarella, Gray, Ann. & Mag. Nat. Hist. (4) v. p. 406.
Brandella, Gray, Cat. Lithophytes Brit. Mus. p. 30.
Plexaura, pars, Klunzinger, Kor. Roth. Meer. p. 52.

Type *Villogorgia nigrescens*, Duch. & Mich. *l. c.*

No good reason seems to exist why Kölliker, writing in 1864, should have replaced the name given in 1860 to this genus by the authors of the 'Mémoire sur les Coralliaires des Antilles' by a fresh appellation, still less for Dr. Gray's action in 1870 in ignoring the work of all three writers. But Kölliker's name may be with advantage retained for a part of his genus.

It may be defined as consisting of Gorgoniidæ with well-branched corallum, with entirely horny axis, scarcely or not at all concealed, except on ultimate branches, by a thin cœnenchyma; covered on all sides by scattered verrucæ; more or less anastomosis of the branches occurs. Verrucæ prominent, cylindrical, surrounded or not by a crown of projecting linear spicules. Spicules of cœnenchyma large, tuberculate, 4–8-stellate, and fusiform; those of verrucæ large, tuberculate, fusiform, accompanied by flattened, superficially tuberculate, and laterally scalloped forms ("Stachelplatten," Kölliker, Icon. Histiol. pl. xvii. fig. 19 *a*, &c.). The genus thus limited would probably include *Paramuricea placomus*, Esper (Köll.), *P. spinosa*, Kölliker (*l. c.*), *P.* (*Villogorgia*) *nigrescens*, Duch. & Mich. (*l. c.*), *P. gracilis*, Studer (*l. c.*), *P. borealis*, Verrill (Am. J. Sci. [3] xvi. p. 213), *Gorgonia cancellata*, Dana, = *Antipathes flabellum*, Pallas, *Brandella intricata*, Gray (*l. c.*), *Lissogorgia flexuosa*, Verrill (Proc. Essex Inst. iv. pp. 43, 187), and perhaps *Antipathes clathrata* and *A. fœniculata*, Esper.

For species without the Stachelplatten of the cortex *Paramuricea* might be retained as a subgenus, although in external characters it cannot be distinguished from typical forms of *Villogorgia*; and the peculiar spicule of that genus is, as Kölliker believes, probably represented by the quadri- and octoradiates of this group. Into this division would fall *Paramuricea intermedia*, Kölliker (*l. c.*), *Boarella flabellata*, Gray (Ann. &

Mag. Nat. Hist. [4] v. p. 406), and a new species, *P. mauritiensis*, described below. It is possible that some of the species referred above to the typical group, *Villogorgia*, s. str., but whose minute characters are imperfectly known, may prove to belong to this division (e. g. *Antipathes flabellum*, Pallas).

Echinogorgia, Kölliker (*l. c.*), appears to be distinguished from *Villogorgia* by the thickness of the cortex, which hides the axis, and by its commonly bright or pale colour.

Villogorgia intricata.

Brandella intricata, Gray, Cat. Lithophytes Brit. Mus. p. 30.

This species (the typical and only species of the genus to which Dr. Gray assigned it) was very shortly described, with, however, a fairly characteristic woodcut of some terminal branches. The type specimens, which are merely the peripheral portions of what was probably a single colony, are in the British Museum; and from them I have obtained details as to the characters of the spicules which justify the course I have taken in suppressing its genus and attaching it to *Villogorgia*.

Spicules of cortex, (i.) fusiform, with rounded ends, covered with numerous inconspicuous rounded tubercles, with two or three rounded projections from the centre at one side, size ·28 by ·044 millim.; or they may have two lateral projections, longer and on opposite sides, and measure ·25 by ·035 millim., thus forming a transition to the well-marked quadriradiate form (ii.), which has four cylindrical radii, the two pairs of radii being usually inclined at an obtuse angle to each other, well tuberculated, with distinct and prominent but small tubercles, size ·18 by ·035 millim. (iii.) Flattened, disk-like, tapering into two or more terminal points, the margin more or less scalloped into teeth, and the surface slightly embossed with low tubercles; a few small fenestræ penetrate the disk; size ·34 by ·18 millim. Polype-spicules (iv.) fusiform, similar to (i.), or with a central zone of long tubercles, size ·35 by ·108 to ·37 by ·071 millim. (v.) Disk-like forms of similar characters and size to those of the general cortex (perhaps really belonging to it).

In external characters it is hardly distinguishable from *V. mauritiensis* (q. v. infrà).

Hab. Dewi(?) Reef, Bass's Strait.

Villogorgia (*Paramuricea*) *flabellata.*

Boarella flabellata, Gray, Ann. & Mag. Nat. Hist. ser. 4, vol. v. p. 406.

Having examined the typical specimen of this species, I

am able to say that it is a true *Villogorgia* of the *Paramuricea* division. The mouths of the verrucæ have the normal number of eight valves, not ten, as stated by Gray; and they are terminated by sharp, distinctly projecting fusiform spicules. The verrucæ are not confined, as a rule, to the lateral margins, as stated by the same author, but, as in other *Paramuriceæ*, distributed over all parts of the surface of the branches. In general appearance it much resembles *V. mauritiensis*. The fusiform cortical spicules (i.) are sharply pointed, have a few angular sharp tubercles, and resemble those of *Echinogorgia intermedia*, Studer; size ·32 by ·035 millim. The stellates of the cortex (ii.) have long slender and rather irregular and curved arms, from four to five in number, the fifth in a different plane from the rest; the body is usually rather elongate; a few medium-sized tubercles on body and arms; maximum length ·212, thickness of body ·035, of arms at base ·026 millim. The spicules of the verrucæ are either (iii.) elongate fusiform, exactly like (i.), but measuring ·46 by ·035 millim., or (iv.) coarser fusiform, with one part bent at a considerable angle to the rest of the spicule, sharply pointed and tuberculate after the same manner as (i.), size ·355 by ·071 millim. Colour greyish brown, except near base, where the black colour of the axis appears through the cortex.

Hab. Unknown.

Obs. The genus *Boarella* lapses altogether, since *B. flabellata* is the type and the only species belonging to it.

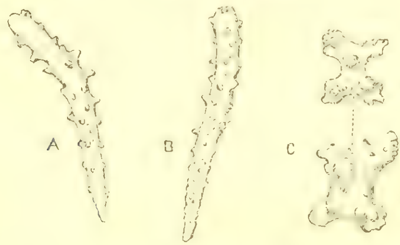
Villogorgia mauritiensis, sp. n. (Fig. 1.)

Corallum branching frequently in one plane; branches subdichotomous, showing tendency to be suppressed on the inner aspect, given off at intervals of from 7 to 28 millim. as a rule; angle of branching varying from about 30° in the case of the larger, to from 45° to 80° in the terminal branches. Stem and main branches slender in proportion to size of corallum; terminal branches filiform, viz. ·4 millim. in diameter excluding the verrucæ; anastomosis frequent in central parts, forming elongate meshes, uncommon near periphery. Axis of main branches strongly compressed laterally, the antero-posterior diameter being about twice that of the lateral diameter. Substance of axis black, glabrous, tough and elastic, and light, except in the ultimate twigs, where it is brown. Cortex very slight, forming a brownish film on the main branches, but not concealing the axis, becoming slightly thicker, viz. about ·07 millim., towards the periphery. Verrucæ distributed over all parts of the branches, not leaving any posterior bare

space; more thickly towards the terminations of the twigs, where they are almost or quite in contact at their bases; distribution approximately alternate; prominent, cylindrical, blunt; length of verrucæ of terminal twigs ·7 to ·75 millim., breadth ·75 millim., those of the larger branches somewhat smaller.

Spicules of general cortex:—(i.) fig. 1, A, linear, the shaft cylindrical, tapering more or less towards one end, the thicker two thirds bearing scattered, rather distant, prominent verru-

Fig. 1.—*Villogorgia mauritiensis.*



A. Fusiform spicule of cortex, × 90 diam. B. Fusiform spicule of verrucæ, × 90 diam. C. Different forms of octoradiate spicule of cortex, × 100 diam.

ciform tubercles, roughened at their free ends, size ·35 by ·053 millim.; (ii.) fig. 1, C, quadriradiate stellates, generally with a somewhat elongate body, almost smooth, from which two pairs of radii are given off in one plane at an angle of from 90° to 135° with one another, and two pairs of similar tubercles on opposite sides of the body, in a plane at right angles to that of the other two pairs, the radii blunt or subacute, bearing some large rough tubercles, or with the body developed at the expense of the rays, which then form merely lateral angles of a short barrel- or capstan-shaped shaft; size ·14 by ·035 millim. Spicules of verrucæ of one kind only, viz. (iii.) fig. 1, B, the same as no. i., but rather longer and with more numerous tubercles, size ·39 by ·053 millim. Colour, dirty black on main branches, wainscot-brown on terminal branches.

Hab. Mauritius, 80 fathoms (coll. Mus. Brit.).

Obs. The single specimen which represents this species was recently obtained from Mr. V. de Robillard in the dry condition. It is of remarkable size, viz. height 32 inches (800 millim.), maximum breadth 18½ inches (462 millim.); the antero-posterior diameter of the first main branch is 7 millim., the lateral diameter 3 to 5 millim. It has an

irregular thin base of parchment-like substance, covering a bivalve shell &c.

Its peripheral portions strongly resemble the type specimen of *V.* (*Brandella*) *intricata*, Gray, in general appearance, but differ in the rarity with which anastomosis occurs in this part of the corallum and in the broader shape of the meshes of the reticulation. It differs in spiculation from that species chiefly in not possessing the flattened tuberculate disks of the cortex; it differs from *V.* (*Paramuricea*) *intermedia* in the inferior proportions of its spicules, and from *V.* (*Plexaura*) *torta* in the much larger size of these parts, and in the more pointed and less strongly tuberculate character of the fusiform spicules. As stated above, the species falls into the *Paramuricea* section of the genus *Villogorgia*.

It is not impossible that specimens of this species may have been included by Studer (MB. Ak. Berlin, 1878, p. 653) under *Paramuricea cancellata*, Verrill, as he describes specimens from the Indian Ocean having a well-marked lateral compression of the branches.

The known species of the subgenus may be thus tabulated:—

	Length of cortical spicules.	Length of polype-spicules.	Colour.	Locality.
	millim.	millim.		
Villogorgia (Paramuricea) intermedia, *Kölliker.*	·18–·55	·4–·62	?	Hab. ?
Villogorgia (Plexaura) torta, *Klunzinger.*	·032–·086	·016–·048	Black.	East of Red Sea.
Villogorgia mauritiensis, sp. n.	·14–·35	·39	Dirty black to brown.	Mauritius.
Villogorgia (Boarella) flabellata, *Gray.*	·21–·32	·35–·46	Greyish brown.	Hab. ?

Menacella, Gray.

Menacella reticularis, Gray.

This, the type species of the genus *Menacella*, founded by Dr. Gray in 1870 (Ann. & Mag. Nat. Hist. ser. 4, vol. v. p. 406), is nominally based on *Gorgonia reticulum* (not *reticularis*, as erroneously printed), Pallas. It strongly resembles species of *Villogorgia* in external characters—that is to say, the type specimen, as labelled by Dr. Gray, in the British Museum; but it is necessary to point out that this is not in reality referable to Pallas's species, which is described by that author as red in colour or "pallida," and as "inter

Gorgonias omnes ponderosissima," whereas this species could hardly be of a less specific gravity, and is coloured grey or dirty white. The species must therefore be cited as *Menacella reticularis*, Gray, nec *reticulum*, Pallas.

In its spiculation it differs very decidedly from the members of the genus *Villogorgia* in having none but simple tuberculate fusiform spicules, with strongly microtuberculate or exfoliating tubercles; the spicules are black in colour, with the exception of the tubercles, which are colourless; the largest measure ·5 by ·101 millim.

Gorgonellaceæ, Valenciennes.

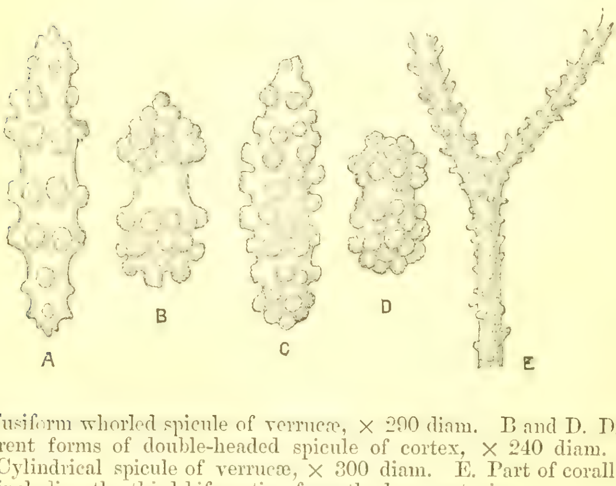
Verrucella, Kölliker (nec M. Edw. & Haime).

Juncella, Klunzinger, pars.

Verrucella candida, n. sp. (Fig. 2.)

Corallum branching dichotomously in various planes; branches few and long and at considerable intervals; the terminal branches, where normally developed, from 3 to 15 inches long (75 to 375 millim.); branches given off at angles of 45° to 90°.

Fig. 2.—*Verrucella candida.*



A. Fusiform whorled spicule of verrucæ, × 290 diam. B and D. Different forms of double-headed spicule of cortex, × 240 diam. C. Cylindrical spicule of verrucæ, × 300 diam. E. Part of corallum, including the third bifurcation from the base, nat. size.

Stem and larger branches cylindrical, the stem 6 millim. thick, the branches decreasing but slightly in diameter to-

wards the periphery of the colony, where they are 2 millim. in long diameter (exclusive of verrucæ), being flattened at this point.

Cortex compact, from ·5 millim. thick on stem, to ·25 millim. on apical portions of branches; surface minutely ridged longitudinally; no longitudinal grooves. Verrucæ prominent, 1 to 2 millim. apart, truncate-conical, 2 millim. long by ·75 millim. in apical diameter, flexible, and apt to become flattened at their external halves; equally distributed over stem and lower parts of branches, but towards free ends becoming almost confined to the lateral surfaces. Axis hard, smooth.

Spicules of cortex of one kind, viz. (i.) double-headed forms with very narrow bare median space, the heads being covered with about three series each of small smooth rounded tubercles; size ·106 by ·062 millim. Spicules of verrucæ of two kinds, viz.:— (ii.) cylindrical, rather blunt, tuberculate, with numerous small rounded tubercles irregularly scattered all over, size ·123 by ·044 millim.; (iii.) fusiform, pointed at ends, with slight median bare space, and on each side of this about four whorls of tubercles like those of nos. i. and ii.; size ·142 by ·044 millim. Colour pure white, that of axis yellowish brown.

Hab. Mauritius, 90 fathoms (coll. Brit. Mus.).

The very fine and perfect single specimen was collected by Mr. V. de Robillard at Mauritius; it is 20 inches (500 millim.) in maximum height, 15 inches (375 millim.) in maximum lateral expansion of branches.

Obs. The very long verrucæ appear to distinguish this from all, and the peculiar mode of branching from most, *Verrucellæ*; in the latter point it resembles *V. granifera*, Kölliker (Icon. Histiol. p. 140, pl. xix. fig. 4), the spicule figured by that author being of similar character to, though more pointed than, no. ii., described above; but the verrucæ of that species are described as but slightly prominent and the cœnenchyma as yellowish brown; it is recorded as from the coast of Africa. I do not feel sure what ought to be the name of the genus; Kölliker seems to have based his genus on the later rather than the earlier species of Milne-Edwards and Haime's genus.

XXIII.—*Note on a Freshwater Macrurous Crustacean from Japan* (Atyephyra? compressa, *De Haan*?). By EDWARD J. MIERS, F.L.S., F.Z.S.

THE specimens which are the subject of this note were sent to the British Museum by my friend Dr. P. Mayer, of Naples, with the request that I should determine the species. They

were collected by an American gentleman, Dr. Whitman, who describes them as occurring very abundantly in freshwater (not brackish) ponds and ditches in the vicinity of Tokio, Japan. Their embryology and development, I am informed, is being studied by Mr. Ishikawa, of the University of Tokio.

These specimens I find upon examination to be very probably identical with the species long ago described by De Haan * as *Ephyra? compressa*, which von Martens† refers to the genus *Atyephyra*, Brito-Capello. As the specimens before me differ in some particulars from the published descriptions, I have thought it useful to place on record the few following notes, which were made while endeavouring to determine the species.

Atyephyra compressa has been hitherto a *desideratum* to the British Museum; nor have we at present in the national collection any specimens of the genera to which it is apparently most nearly allied—*Troglocaris*, Dormitzer, and *Miersia*, Kingsley (= *Ephyra*, Roux). My observations, which refer only to the external characters proper for distinguishing the genera and species, will, I trust, in no way interfere with, but merely supplement Mr. Ishikawa's work, which will, I believe, ere long be published.

Atyephyra compressa differs from the Portuguese species, *Atyephyra rosiana*, on which Brito-Capello founded the genus *Atyephyra* ‡, in that the palpiform appendages articulated with the bases of the thoracic limbs (exopodites) are wanting to the three posterior pairs in *A. rosiana*, and the palm or penultimate joint in the first and second legs is somewhat excavated at its proximal end. I have not either the time or material necessary for a comparative study of the genera of Atyidæ; but I think it probable that the presence of these palpi upon all the thoracic limbs in the Japanese species may be a character sufficient to separate it generically, when I would propose to designate it *Paratya*. There are specimens in the collection of the British Museum from a freshwater stream near Cintra, presented by the Rev. A. E. Eaton, that I refer to *Atyephyra rosiana*, which only differ from Brito-Capello's specific description in having the

* In von Siebold's 'Fauna Japonica,' Crustacea, p. 186, pl. xlvi. fig. 7 (1849).

† Archiv f. Naturgeschichte, xxxiv. p. 51, pl. i. fig. 4 (1868).

‡ "Descripção de algunas especies de Crustaceos, &c.," in Mem. Ac. Sci. Lisboa, iv. p. 61, pl. i. fig. 1 (1867).

terminal postabdominal segment not acute, but somewhat rounded at its distal extremity; the number of rostral teeth (in five specimens) varies between $\frac{26}{4}$ and $\frac{33}{7}$.

I may be allowed to point out, moreover, that the presence of these palpiform appendages (exopodites) both in *Atyephyra* and the nearly allied genus, *Troglocaris*, Dormitzer *, which inhabits caves in Carinthia, necessitates the removal of these genera from the subfamily Atyinæ to the Ephyrinæ, as characterized by Mr. Kingsley in his very useful synopsis of the genera of Crangonidæ, Atyidæ, and Palæmonidæ †.

Troglocaris differs from *Atyephyra* in its rudimentary eyes and in the more largely dilated penultimate joints of the thoracic limbs; *Miersia* (*Ephyra*) has a marine habitat, and, as von Martens has shown, is distinguished by possessing a mandibular palpus ‡, by the position of the inferior lateral spine of the carapace, the carinated postabdomen, and by other characters.

As regards specific distinctions, the specimens received from Tokio differ from De Haan's original description of *A. compressa* in having the rostrum armed with fewer teeth on the upper and lower margins, and the postabdominal appendages biramose, not simple, as stated by De Haan. In the figure in the 'Fauna Japonica,' however, they are represented as biramose; so possibly De Haan's description is after all incorrect as regards this particular. With regard to the dentition of the rostrum, De Haan says that the upper margin has twenty to twenty-four teeth, and the lower margin four teeth; the largest number of rostral teeth in any specimen I have examined is $\frac{14}{2}$ and $\frac{13}{3}$; this, however, is a very variable character, since scarcely two specimens out of fifteen examined by me were found to agree exactly in this particular; in one there were only $\frac{7}{3}$ teeth. Von Martens figures an example with $\frac{8}{2}$ teeth. There can, I think, be no doubt of the specific identity of his specimens (which were obtained at Yokohama) with ours; but it remains for naturalists working in the country and with larger material to determine whether this species be indeed the *Atyephyra? compressa* (De Haan) or a distinct but closely allied form.

* Lotos, iii. p. 85, pl. iii. (1853).

† Proc. Acad. Nat. Sci. Philad. p. 415 (1879).

‡ Mr. Kingsley's diagnosis of his family Atyidæ needs emendation as regards this character.

XXIV.—*Descriptions of new Species of Myriopoda of the Genus* Zephronia *from India and Sumatra.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

The following species have been received during the last two or three years, and are all perfectly distinct from any species hitherto named.

1. *Zephronia tumida*, sp. n. (Fig. 1.)

Head and nuchal plate blackish; first dorsal segment dull castaneous, clouded on the borders with blackish; second to eleventh dorsal segments with a broad ochraceous band in front (the anterior margins of these bands being laterally excavated), otherwise blackish; a faint indication of a dusky dorsal line down the centre and one or two blackish dots here and there upon the ochreous bands; last dorsal segment dull castaneous, with blackish posterior margin; eyes, antennæ, and tarsal claws blackish, and remainder of legs dark piceous as usual.

1

Head rather narrower than usual, sparsely but deeply punctured, more finely and densely in front, obliquely shelved in front and deeply impressed with a small anchor-shaped embossed marking just above the mouth; the central area and sides longitudinally swollen, as in no other species; the posterior margin rather deeply excavated; nuchal plate a little shorter and less tapering at the extremities than in the allied species, with a linear anterior marginal carina, coarsely and sparsely punctured excepting along the anterior border, where the punctures are numerous, fine, and irregular; dorsal segments finely but densely and deeply punctured, almost granulose; the lateral wings of the first segment narrow, granulose, with very slender marginal carina; terminal segment, viewed in profile, very slightly oblique, with a slight depression at its posterior third. Length 48 millim.; width 21 millim.

N. Assam. Type, B.M.

I have taken the above description from a single adult spirit-specimen recently presented to the collection by F. O. P. Cambridge, Esq. The species in coloration and pattern comes nearest to *Z. tigrina* and *zebraica*, but differs from the former in its more swollen head, greater width, and altogether different punctuation, and from the latter in its swollen instead of smooth head, densely punctured segments, and differently formed terminal segment.

2. *Zephronia marmorata*, sp. n.

Blackish piceous, irregularly blotched with reddish castaneous; head black, excepting at the back, which is piceous, indistinctly spotted with reddish castaneous; nuchal plate piceous, with castaneous margins; terminal segment piceous, with broad irregularly undulated posterior border.

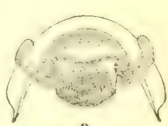
In structure it approaches *Z. zebraica* (of which we possess the type dried and two magnificent spirit-examples, received from the India Museum); but it is more convex, a little narrower; the head, instead of being smooth with a few scattered coarse punctures over the posterior two thirds, is somewhat flattened and irregularly rugose; the nuchal plate is also flattened; but possibly this may be an abnormal condition due to shrinking. It is, however, distinctly broader in the middle, the dorsal segments are slightly roughened, not punctuated, excepting the terminal segment, which is rather coarsely granulose and laterally a little compressed. Length 47 millim., width 22 millim.

India, exact locality unknown. Type, B.M.

In its marbled character this species comes nearest to the beautiful Ceylonese species *Z. versicolor* of White; the latter, however, is a brilliantly polished species, with coarse punctuation along the front of the segments, and differing altogether in the outline of the first dorsal segment, which in *Z. marmorata*, when viewed from the front, forms a regular arch.

3. *Zephronia barbata*, sp. n. (Fig. 2.)

Nearest to *Z. lævissima* of India. Head blackish, brown in front; nuchal plate and first dorsal segment blackish; second to fifth segments piceous, slightly reddish in front; sixth to eleventh segments castaneous, with their anterior borders broadly pale testaceous, and the posterior margins blackish; terminal segment dark castaneous.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Head quadrate, very feebly excavated behind, with a rather shallow angular anterior carina behind the mouth; slightly depressed on each side in front, rugulose, with a few shallow coarse punctures, anterior two fifths covered with rather dense short brown hair; the whole of the head, however, is more or less hairy; nuchal plate convex, smooth, rather short and broad. Lateral wings of first dorsal segment rather wide and with well-defined marginal carina; all the dorsal segments smooth, shining, excepting along the anterior borders, which

are dull, and crossed longitudinally by short shining embossed lines and dots, unlike those of any known species of this genus. Length 28–42 millim., width 14–21 millim.

Sumatra (*Carl Bock*). Type, B.M.

From three dried examples in the collection.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

January 25, 1882.—R. Etheridge, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "On the Fossil Fish-remains from the Armagh Limestone in the Collection of the Earl of Enniskillen." By James W. Davis, Esq., F.G.S., F.L.S.

The author described in this paper a large collection of fossil fish-remains at present at Florence Court, Enniskillen, but which will soon be removed to the new Natural History Museum in the Cromwell Road. The collection comprises, besides specimens collected by the Earl of Enniskillen from the Carboniferous Limestone of Armagh, a large series acquired from the famous collection of the late Captain Jones, M.P., the remaining portion of which is in the Geological Museum of Cambridge. Several genera and species were described by Prof. Agassiz in his 'Recherches sur les Poissons Fossiles' (1833–43), and again referred to by J. E. Portlock, F.R.S., in his 'Report of the Geology of Londonderry and parts of Tyrone and Fermanagh' (1843).

In 1854 Prof. M'Coy described many new genera and species in his work on the British Palæozoic Rocks and Fossils, principally derived from a study of the portion of Capt. Jones's collection deposited in the Cambridge Museum. Prof. Agassiz paid a visit to Florence Court in 1858, and appended names to some of the fossil teeth in Lord Enniskillen's cabinets, intending to describe and figure the new forms, and to revise the whole of his former work. His death prevented this intention from being carried into effect. As far as possible the determinations of Prof. Agassiz have been adhered to in the present paper.

The detached and isolated condition in which the remains are found renders any appreciation of the relationship of the teeth and spines, or even of the teeth only, to each other extremely uncertain and difficult. Some speculations as to the probable organization and characteristics of the Carboniferous fishes which they represent, evolved during a long consideration of the specimens, have therefore been postponed to a future opportunity.

The following is a list of the genera and species described in the paper:—

Ctenacanthus plicatilis, *C. dubius*, *C. lævis*, *C. pustulatus*, *C. tuberculatus*, *Compsacanthus carinatus*, *Cosmacanthus marginatus*, *C. carinatus*, *Lispacanthus retrogradus*, *Cladacanthus paradoxus*, *C. major*, *Gnathacanthus triangularis*, *Cladodus polygodon*, *C. curvus*, *C. destructor*, *Carcharopsis Colei*, *Copodus cornutus*, *C. furcatus*, *C. spatulatus*, *C. minimus*, *Lobodus prototypus*, *L. planus*, *Mesogomphus lingua*, *Pleurogomphus auriculatus*, *Rhymodus transversus*, *R. oblongus*, *Characodus angulatus*, *C. lunatus*, *Pinacodus gonoplax*, *P. gelasi*, *Dimyleus Woodi*, *Mylax batoides*, *Mylacodus quadratus*, *M. Sesarma*, *Homalodus trapeziformis*, *H. quadratus*, *Petalodus quadratus*, *P. recurvus*, *P. inequilateralis*, *Polyrhizodus magnus*, *P. Colei*, *P. elongatus*, *P. sinuosus*, *P. attenuatus*, *P. constrictus*, *Chomatodus linearis*, *C. acutus*, *Glossodus marginatus*, *Harpacodus dentatus*, *H. clavatus*, *Streblodus oblongus*, *S. Colei*, *S. Egertoni*, *Deltodus sublævis*, *D. expansus*, *D. nobilis*, *Deltoptychius acutus*, *D. gibberulus*, *Sandalodus Morrisii*, *Psephodus magnus*, *Pœcilodus Jonesii*, *P. gibbosus*, *Tomodus convexus*, *Xystrodus striatus*, *X. angustus*, *X. Egertoni*, *Helodus crassus*, *H. tenuis*, *H. clavatus*, *H. dilatatus*, *H. acutus*, *H. richmondensis*, *H. triangularis*, *H. biconus*, *H. expansus*, *Rhamphodus dispar*, *Petalorhynchus psittacinus*, *Pristodus falcatus*.

2. "On an extinct Chelonian Reptile (*Notochelys costata*, Owen) from Australia." By Prof. Owen, C.B., F.R.S., F.G.S.

The fossil reptilian remains hitherto transmitted to the author from Australia have been limited to parts of the skeleton of *Megalania prisca*, Ow. The present specimen, sent last year by Prof. Liversedge, is the first fossil Chelonian. The specimen was found in a formation at Blinder's River, Queensland, of which the nature and age are not stated. It is, however, petrified. The fossil consists of the anterior portion of the carapace and of the plastron, brought into unnaturally close contact by posthumous pressure. A minute description of the several parts was given, from which the author concluded that though the characters of the carapace might be interpreted as identifying the Chelonian with a true turtle (*Chelone*), those of the plastron show the well-marked distinctions of *Trionyx* and *Chelys*. On the whole, however, the modifications, especially of the carapace, show a nearer affinity to the marine turtles (*Chelone*) than the known Chelydrians exhibit, and indicate a more generalized type.

February 8, 1882.—R. Etheridge, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "Description of some Iguanodon Remains discovered at Brook, Isle of Wight, indicating a new Species, *Iguanodon Seelyi*." By J. W. Hulke, Esq., F.R.S.

After referring to the *Iguanodon* remains preserved in the

Brussels Natural-History Museum, the author described some fossils obtained by him in 1870 from a bed between the red and purple clays and the flint gravel capping the cliff in Brook Bay. The ilium, when complete, was not less than 124 centim. long, with a maximum vertical extent of 33 centim. The dorsal border is stout, and slightly overhangs the outer surface. The præacetabular process is relatively short; and the postacetabular part of the bone tapers more than in Mantell's *Iguanodon*. The femur, when entire, could not have been less than 108 centim. long; the girth of the condyles is 82 centim., and their breadth 32 centim.: the tibia is shorter than the femur. Both metatarsi demonstrate the existence of but three functional toes; the middle metatarsal is the longest, attaining 35·5 centim., the outer metatarsal 29 centim., and the inner 26 centim.; the inner toe has three phalanges, the middle four, and the outer toe five. The toes of the *Iguanodon* therefore correspond to the second, third, and fourth toes of *Hypsilophodon*. The ungual phalanx of the inner toe is 17 centim. long, that of the middle toe nearly 18 centim. long, and that of the outer toe about 15·5 centim. long.

The humerus is about 10 centim. long. Its proximal end has a well-developed posterior or inner process, and a large deltoid crest. The caudal vertebræ, three probably between the 4th and the 10th in this series, have very four-sided articular surfaces suggestively like those hitherto referred to *Pelorosaurus*. The chevron bones are very stout and long. The differences in their ilia show this and Mantell's *Iguanodon* to be specifically distinct; and with this new *Iguanodon* the author connected the name of C. Seely, Esq., M.P., of Brook House, in recognition of his courteous permission to excavate the cliff for the recovery of the fossils, naming it *Iguanodon Seelyi*.

2. "On a peculiar Bed of Angular Drift on the high Lower-Chalk Plain between Didcot and Chilton." By Prof. J. Prestwich, M.A., F.R.S., F.G.S.

In making a railway from the main line to Chilton, this bed of drift was cut through for a distance of about $1\frac{1}{4}$ mile. It lies on a flat plain extending from the foot of the escarpment of Upper Chalk to the top of that of Lower Chalk. In places it is full 28 feet thick. At first a fine chalk rubble, it becomes after a while coarse, and is divided by clay-beds into an upper and a lower deposit. Here small boulders and bones occur, the latter much shattered; but *Elephas primigenius*, *Rhinoceros tichorhinus* (?), *Bison priscus*, *Cervus tarandus*, *Equus*, &c. have been identified. The boulders are Sarsen-stone; and there are small fragments of flint. Shells of *Pupa marginata*, *Helix hispida*, and *H. pulchella* have been found. The drift (which is widely spread) is from 150 to 260 feet above the Thames; at highest 407 feet above the sea. The author compares it to the rubble-beds overlying the raised beaches of Sangatte and Brighton. It is unconnected with any river-course, is not of marine origin, and its materials, where not local, are derived from the southward.

BIBLIOGRAPHICAL NOTICE.

Conchologische Mittheilungen als Fortsetzung der Novitates Conchologicæ. 8vo. Cassel: Verlag von Theodor Fischer, 1881.

Such is the title of a work, of which the first volume is now before us, brought out under the able supervision of Dr. E. von Martens, of Berlin. It is published in octavo form, instead of quarto like the important work of which it is a continuation, consists of 101 pages of text and 18 coloured plates. The entire volume, with the exception of a single treatise by Dr. Böttger, of Frankfort, on the species of *Pupa* of Oceania, is from the pen of Prof. Martens, which in itself is a guarantee of its excellence. In an introductory chapter the author explains the sense in which he employs the different terms of measurements of univalve shells, also the terms applied to the various colour-markings on their surface, and the direction in which they are placed, concluding with similar observations regarding bivalve Mollusca. The thirty succeeding pages give an account of a number of interesting Helicidæ, principally from Central Asia. All of these are fully described and figured; and although many of them are not absolutely new to science, still the detailed descriptions, accompanied by many valuable notes on allied species, and a complete synonymy, are none the less welcome. Further on, other species of Pulmonata are treated upon, of which *Tornatellina gigas*, from the Caroline Islands, is perhaps the most striking. Pages 33–49 contain descriptions of some remarkable marine Gastropods, notably a large species of *Pleurotomaria* from Japan, being the fourth living representative of a race which until quite recent times was regarded as extinct. Dr. Böttger's paper on the Pupidæ of Oceania is a most valuable contribution to our knowledge of these minute forms. In conclusion, we must call attention to the excellence of the plates, which, without exception, have every appearance of accuracy; and in some individual cases the figures are really artistic. The coloration is good, not being exaggerated, as is the case in some works on conchology. We trust that a publication of such utility to conchologists will meet with the support it deserves, and that the second and succeeding volumes will retain the high character of the first.

MISCELLANEOUS.

On some peculiar Organs of Eudendrium ramosum. By Dr. August Weismann.

In investigating the origin of the sexual products in *Eudendrium ramosum* Dr. Weismann has discovered some singular organs, of which there is never more than one upon the side of each calyx. They have nearly the appearance of the tentacles, but are three

times as thick, in certain cases even equal in thickness to the stem. They present the two layers which constitute the walls of the body, and contain a prolongation of its cavity. They are present only on a small number of hydranths, about one ninth of the whole. They are capable of movement, as, indeed, is indicated by the presence of a strongly-developed muscular layer, and are furnished with a great abundance of urticating organs, whence the name of *cnidophores* given to them by Dr. Weismann. These urticant capsules are more especially grouped at the extremity of the cnidophore, where they form several layers among the cells of the ectoderm. In the deeper layers of the endoderm there are subepithelial cells giving origin to circular muscular fibres which present nuclei, and upon which a striation is observed here and there.

The cnidophores only make their appearance in hydranths which have attained their full development. They show themselves first of all in the form of an elevation of the ectodermic wall, situated upon a small annular projection which occurs at the lower part of the calyx, and which Dr. Weismann calls the *urticant wall* (Nesselwall). This name has been given to it because it is the part of the calyx which contains the greatest quantity of urticating organs, at any rate in *Eudendrium ramosum*. Below this urticant wall there is an annular groove; and immediately beneath this groove is seen what Dr. Weismann calls the *glandular ring* (Drüsenring). At this point the ectoderm only presents a layer formed of cells which produce a viscous secretion.

If, on the one hand, it is evident that the cnidophores are powerful weapons for the hydroids which possess them, on the other it is difficult even for so sagacious a naturalist as Dr. Weismann to understand their special use, since they are the appanage of only a small proportion of the hydranths of a colony.

There are two points to be noted with regard to these singular organs—namely, that they do not occur in the other species of *Eudendrium*, and that they occupy a completely asymmetrical position. The author compares the cnidophores with certain structures met with in the Hydractinidæ, the Plumularidæ, the Milleporidæ, &c., and which one might be tempted to regard as their homologues. He shows that they differ from these completely from a morphological and histological point of view, and that we have to do here with organs of a special nature.—*Mittheil. aus der zool. Stat. zu Neapel*, vol. iii., 1881; *Bibl. Univ., Arch. des Sci.*, January 15, 1882, p. 103.

Note on the Pearly Organs of Scopelus.

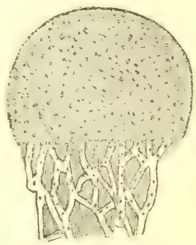
By H. B. Guppy, M.B., Surgeon R.N.

Dr. Günther* has called upon travellers to examine fresh specimens of pelagic fishes provided with "luminous organs," in order to ascertain, if possible, the functions of these organs, and also to discover whether or not the luminosity (if such be their function) is

* 'Introduction to the Study of Fishes,' p. 706.

subject to the will of the fish. I have recently had the opportunity of observing some fresh-caught *Scopeli.*

On the night of October 18, 1881, when near the Cape of Good Hope (in lat. 35° 45′ south, long. 12° 30′ east), the net brought in a small *Scopelus**, which was unfortunately dead. It could not have been in the net for more than a few minutes; but a very short delay in hauling in appears sufficient to kill these animals; and, in fact, in order to obtain them alive it would be necessary to examine the net every five minutes. The individual I caught was about two inches in length, and possessed the characteristic pearly bodies on the sides of the head and body; in addition, there were seven other considerably larger pearly organs arranged along the dorsal border of the body close to the caudal fin. No luminosity was exhibited by these organs; nor did irritation excite its display. I examined the larger of these bodies, those from the dorsal border, and found them to vary in diameter from $\frac{1}{300}$ to $\frac{1}{400}$ of an inch. Each consisted of a limiting membrane investing a dense mass of granular and nuclear matter, which was ejected with some degree of force when the membrane was ruptured. The form of the organ is shown in the accompanying rough sketch: from its posterior or flattened surface springs a fine network of tubes or vessels freely anastomosing, and varying in size from $\frac{1}{2000}$ to $\frac{1}{1500}$ of an inch across. The same granular material filled these tubes; but it was somewhat diffluent, and in one of the organs I examined there was a decided flow of the contents of the tube for a short period, though it may have been due to the pressure of the covering-glass. I was not able to trace the mode of origin of these tubes with exactitude; and I should also observe that, under the microscope, muscular tissue was generally to be noticed amongst the substances adhering to the detached organ; but whether it had any particular relation to the pearly organ or was simply brought up with the deeper tissues, I was unable to determine.



Pearly organ from a *Scopelus* taken off the Cape of Good Hope. Size of the tubes $\frac{1}{2000}$ to $\frac{1}{1500}$ inch; size of organ $\frac{3}{100}$ to $\frac{4}{100}$ inch.

On the night of November 7, 1881, in about the same locality (lat. 35° 17′ south, long. 17° 43′ east), two *Scopeli* were caught at night, one dead and the other gasping; both of them were of the same size as the former specimen I obtained; but they were destitute of the large dorsal pearly bodies which I have described. The dead one evinced no luminosity; nor did it exhibit any on irritation; but the one that had some life remaining displayed a faint though an undoubted luminosity in the pearly bodies of the pectoral region, which were larger than those which were situated on other

* This specimen appears to me to be the same as that depicted in the 'Study of Fishes' (*Scopelus boops*).

parts of the body; irritation failed to diminish, or increase, or even to excite the effect.

With reference to the moot point as to whether these bodies are accessory eyes or merely luminous organs, I may mention that one of the causes of the diffused phosphorescence of the sea I have observed to lie in the bright phosphorescence constantly emitted by the eyes of a small shrimp (about half an inch in length) which abounds in the South Atlantic; we have in this animal, therefore, an instance of a "luminous eye." I hope you will pardon this suggestion of mine; but I thought it right to insert it, in the event of there being any thing novel in it.

H.M.S. 'Lark,' Sydney,
December 1881.

On the Occurrence of Centrolophus pompilus *on the East Coast of England.* By Dr. A. Günther.

I am indebted to Henry Laver, Esq., for a very fine example of the Black-fish (*Centrolophus pompilus*), which was caught on the 20th of November last by Captain Cranfield of Rowhedge, at the mouth of the Colne.

The majority of the British specimens of this fish have been obtained on the coast of Cornwall; and, so far as I am aware, this is the first instance known of the fish having wandered so far eastwards.

The oldest Artiodactyle. By E. D. Cope.

Members of this order have been found in the Upper Eocene of North America (*Achænodon*); but none have been determined as yet from the American Suessonian or Lower Eocene. A species represented by teeth from the Siderolitic beds of Switzerland has been referred to *Dichobune* (*D. campichii*, Pict.); but dental characters alone are not sufficient to distinguish that genus from the Perissodactyle Phenacodontidæ*. Dr. Lemoine found astragali of a small Artiodactyle in the Suessonian of Reims, which he has recently ascribed to his *Lophiochœrus Peroni*, which he believes (Proceedings French Assoc. Adv. Sci., Montpellier, 1880) to be a suilline. I have reported an astragalus from the Wind-River formation of Wyoming Territory, which is almost exactly similar to those found by Lemoine. A specimen of *Mioclænus brachystomus*, Cope, now to be described, enables me to characterize with some degree of completeness this interesting form, which precedes in time all the known American Artiodactyla.

The characters of the tarsus are typically those of the order Artiodactyla. The astragalus exhibits a distal trochlea which is continuous with the sustentacular facet, and which articulates with both cuboid and navicular bones.

* See 'American Naturalist,' 1881, December.

The distal portion of the fibula is free from the tibia; and its shaft becomes very slender; but it is possible that a more perfect specimen would display it as continuous. Its distal extremity articulates with the ascending tuberosity of the calcaneum. The cuboid facet of the latter is narrow. The cuboid and navicular are distinct from each other and the cuneiforms; the mesocuneiform is shorter than the ectocuneiform, and *is co-ossified with it.*

There are probably four metatarsals. The median pair are distinct, but appressed; their section, together, subcircular; the lateral metatarsals are slender; the external one is wanting, but its facet on the cuboid is very small.

These characters are in general similar to those of the genus *Dichobune*; but Cuvier* does not state whether the cuneiforms are co-ossified in that genus or not. They are united in *Anoplotherium.*

Mioclænus differs from *Dichobune* in the presence of but one internal tubercle of the superior molars, and in the single external tubercle of the superior premolars. Both genera are referable to a family to be distinguished from the Anoplotheriidæ by the presence of external digits. This has been already named by Gill the Dichobunidæ. The genus *Lophiochœrus* is not yet fully characterized; but its inferior true molars are very elongate and have their cusps connected by oblique ridges.—*Amer. Nat.*, Jan. 1882.

On the Genus Cladocora, *Ehrenberg.* By Dr. A. von Heider.

The author finds the structure of the polypes of *Cladocora* to agree exactly with that of the Actiniæ, and only the basal half of the polype modified by the acquisition of the solid calcareous skeleton.

The exclusively mesodermal formation of the skeleton, already established for the larvæ of Corals, is confirmed in *Cladocora*; and the author describes a cell-layer originating from the mesodermal lamella, and situated between it and the calcareous matter, the elements of which he names *chalicoblasts.* Within the chalicoblasts are produced the calcareous particles which unite to form the well-known acicular systems shown by sections of the coral skeleton. By the chalicoblasts calcareous material is gradually secreted at the external surface of the polype; and by this means the growth of the polypary, in the direction of its longitudinal axis, is effected, while the body of the polype itself is implicated in this only in so far as that it is *in toto* pushed upwards.—*Anzeiger d. kais. Akad. Wiss. in Wien*, December 15, 1881, p. 272.

The Characters of the Tæniodontia. By E. D. Cope.

Additional material gives the following results with regard to the affinities of this suborder. There are three allied groups, represented

* 'Ossemens fossiles,' v. p. 183. Gaudry, Enchaînements du Règne Animal,' p. 147.

by the genera *Esthonyx*, *Tillotherium*, and *Calamodon* of the American Eocene, which are equally unlike each other. *Esthonyx*, as I long since showed, is related to the existing *Erinaceus*—very nearly, indeed, if the dentition alone be considered. Its anterior incisor teeth are unusually developed, and have, as in *Erinaceus*, long roots. One pair, at least, in the lower jaw has enamel on the external face only, and enjoys a considerable period of growth. The genus *Tillotherium* is (*fide* Marsh) quite near to *Esthonyx*; its molars and premolars are identical in character with those of that genus, the only important difference being found in the incisors. Here one pair above and one pair below are faced with enamel in front only, and grow from persistent pulps as in the Rodentia. This character has been included by Marsh in those he ascribes to his "order" of Tillodontia; but as he includes *Esthonyx* in that order*, which does not possess the character, it is not very clear on what the supposed order reposes. The rodent character of the incisors is the only one I know of which distinguishes *Tillotherium* from the Insectivora. I have on this account retained the Tillodontia as a suborder, and referred *Esthonyx* to the Insectivora.

The Tæniodontia agree with the Tillodontia in the possession of a pair of inferior incisors of rodent character; but it adds several remarkable peculiarities. Chief among these is the character of the inferior canines. In the Tillodontia they are either wanting, as in *Erinaceus*, according to the Cuvierian diagnosis, or they are insignificant. In *Calamodon* they are of large size, and, though not so long-rooted as the second incisors, grow from persistent pulps. They have two enamel faces, the anterior and posterior, the former like the corresponding face of the rodent incisors. The function of the adult crown is that of a grinding tooth. This character distinguishes *Calamodon* as a form as different from *Tillotherium* as the latter is from *Esthonyx*. There are, however, other characters. The external incisors, wanting in *Tillotherium*, are here largely developed, and, though not growing from persistent pulps, have but one, an external band-like, enamel face. Their function is also that of grinders. The fact that the rodent teeth in the lower jaw are the second incisors, renders it probable that those of the Tillodontia hold the same position in the jaw. This is to be anticipated from the arrangement in *Esthonyx*, where the second inferior incisors are much larger than the first and third. The superior dentition of the Tæniodontia is unknown. There are two families, the Ectoganidæ with two species, and the Calamodontidæ with five species.—*Amer. Nat.*, Jan. 1882.

On a small Collection of Lepidoptera, principally from Candahar. By Arthur G. Butler.

In 1879 we received from Lieut.-Colonel Charles Swinhoe a collection of Lepidoptera from Western India, Beloochistan, and Afgha-

* Report of U.S. Geol. Survey 40th Parallel, by Clarence King, vol. i. p. 377.

nistan, an account of which I published in the 'Proceedings of the Zoological Society' for last year.

Towards the end of the year Colonel Swinhoe was in London for a short time; and before returning to India he placed in my hands for identification a small series of butterflies and moths collected by him in Kurrachee, Beloochistan, and Afghanistan. Notes upon most of the species accompanied the collection*.

The following is a list of the species:—

RHOPALOCERA.

1. *Epinephele interposita* ♀, Erschoff. Chaman, S. Afghanistan, 11th May.

Captain Roberts also took a single male at Kandahar.

2. *Epinephele roxane* ♂, Felder. On the Khojak (Chaman), on the 13th June.

We have this species from Kandahar.

3. *Hipparchia thelephassa* ♂, Hübner. Chaman, 11th May. It occurs also at Kandahar.

4. *Hipparchia anthe* ♀, var.?, Boeb. Taken on the 14th May at Chaman.

It differs somewhat from European examples on the under surface; but it would not be safe to regard it as distinct until more examples have been seen.

5. *Hipparchia parisatis*, Kollar. The only butterfly seen in a long ramble on the 21st May, 1880; it was "caught amongst a small plot of potatoes."

6. *Pyrameis cardui*, Linn. Kandahar.

"Kandahar, October, November, March, and April. The gardens about Kandahar are full of them; in the last two months they were in regular swarms. I send you the only one I appear to have kept; it is very large."—*C. S.* The specimen is of about the ordinary size of the European examples; and therefore it would appear that the majority of the Afghan specimens were small.

7. *Lampides bœticus*, Linn. Quetta, Beloochistan. "A few both in September and May; never met one beyond."—*C. S.*

8. *Lycæna fugitiva* ♀, Butler. Taken at Quetta in May 1881; it is larger than a female previously received and more brightly coloured, but agrees in its markings.

9. *Lycæna persica*, Bienert. "Kandahar, October and November, very common; many Quetta examples."—*C. S.*

The specimens from Quetta are, however, in all probability males of *L. fugitiva*.

* Unfortunately several of the rarer species are unique in the collection, and therefore cannot be retained for the Museum.

10. *Chrysophanus phlœas*, Linn. Kurrachee, in November; Kandahar, in October, November, and January.

Var. *timœus*, Cramer. Kandahar, in October.

Var. *stygianus*, Butler. Kandahar, in October.

An examination of the forty-one examples of this species obtained at Kandahar, and submitted to me for examination, has shown that the form named by me *C. stygianus* cannot be specifically separated from *C. phlœas*.

11. *Strymon mirabile* ?, Erschoff. Taken at Chaman on the 16th May.

This specimen is in such bad condition that I am doubtful of its identification; it may be *Thecla mirabilis* ♂, Erschoff.

12. *Aphnæus acamas*, Klug. "Only observed at Chaman; eight taken in May, and one in October."—*C. S.* A male left with me is labelled 14th May; but two females as "caught in a maize-field near Chaman, 16th August, 1880.—*H. S. W. S. Barnes*." A fourth example was so much shattered as to be worthless.

13. *Colias sareptensis*, Staud. Four examples, ♂ ♀, taken at Kandahar in October.

14. *Colias pallida*, Staud. Ten examples, ♂ ♀. Kandahar, in March and April.

In my paper upon the collection made by Captain Roberts I have treated this form as a hybrid between *C. sareptensis* and *C. erate*; but, if this be the case, it is singular that the present collection contains three times as many of this form as of the typical *C. sareptensis*, and also that none of them are indicated as taken in October, which latter fact would indicate that, if a hybrid, it is one only produced in the spring months.

15. *Colias erate*, Esper. ♂ ♀, Kandahar, in March, April, and October; those of the last-named month all females.

Colonel Swinhoe naturally failed to discriminate between *C. sareptensis* and the females of *C. pallida* and *C. erate*, as also between the males of *C. pallida* and *C. erate*. The former appears to me to be designated in the following note as the "largest kind" (or this may refer to some only of the specimens, others not noticed being *larger* yet so like the *largest* as to be mentally included with them); the latter is probably "the smaller kind with imperfect black border on primaries." This is the note:—

"*Colias*.—One example of the largest kind taken at Chaman in May, three at Kandahar in October, one in November, and seven at Quetta in May.

"Of the smaller kind, with imperfect black border on primaries, two examples taken at Kandahar in November, one in October."—*C. S.*

I doubt if any description alone would satisfactorily point out to a collector the exact differences by which these forms could be at once separated; but the distinctions, such as they are, may be summed up thus:—

Colias sareptensis.

♂. Yellow, rather brighter than the European *C. hyale*, but with the spotted border more like that of *C. erate* ♀.

♀. White, like the variety *C. helice* of *C. edusa*, the hind wings clear with indistinct orange spot.

Colias pallida.

♂. Yellow, like *C. erate* ♂, but usually smaller, and with a series of indistinct yellow spots through the centre of the outer border of the primaries.

♀. White, much as in the preceding species, but sometimes a little more yellow in tint; the hind wings decidedly greyer, with the orange spot large and vivid; a fairly well-defined submarginal series of bell-shaped pale spots.

Colias erate.

Yellow in both sexes; ♂ with black border, as in *C. edusa*, the ♀ with spotted border, much as in that species; hind wings with spotted border and conspicuous orange spot.

16. *Teracolus fausta*, Olivier. Kandahar, in October.

"Common in October and November; seen in no other months."

A continuation of this note in the next line seems to imply that the species is common in Quetta and also in India. I have not seen any from Quetta; but the species from Scinde (*T. solaris*), obtained by Lieut.-Col. Swinhoe, is very distinct, and is, so far as we know at present, restricted to Scinde.

17. *Belenois mesentina*, Cramer. ♀, Quetta, in May; ♂, Kandahar, in October.

Also said to be common at Kandahar in November and April.

18. *Synchloe daplidice*, Linn. ♂ ♀, Quetta, in May; ♂ caught in a maize-field near Chaman on the 16th August, 1880, by H. S. W. S. Barnes.

19. *Pamphila karsandra*, Moore. ♂ ♀, Kandahar, October and November.

Of the female Col. Swinhoe remarks:—"Scarce: have a few Quetta examples." It should, however, be observed that the female was supposed to be *P. mathias*, and therefore may be distinct from those taken at Quetta.

20. *Erynnis dravira*, Moore. ♂ ♀, Kandahar, October. "Kandahar, October, November, and April; very common; have many Quetta examples."—*C. S.*

HETEROCERA.

21. *Macroglossa stellatarum*, Linn. "Kandahar, November, December, and January, very common: have many Quetta examples."—*C. S.*

22. *Deiopeia thyter*, Butler. "Kandahar: only one example. I have many Quetta specimens."—*C. S.*

23. *Leucania Loreyi*, Dupon. "Quetta, in May."—*C. S.*

24. *Spælotis undulans*?, Moore. Dubrai, on the 3rd October 1880. It is very rare in collections: we have only a single specimen in the Museum.

25. *Agrotis aversa*, Walk. Kandahar, in April: it is rare in collections.

26. *Agrotis segetum*, Denis. Dubrai, on the 3rd October 1880; it is a little paler than European specimens.

27. *Heliothis armigera*, Hübn. Kandahar, in April 1881.

28. *Agrophila sulphuralis*, Bergstr. Kandahar, in November.

29. *Plusia circumflexa*, Linn. Kandahar, in October.
We only possess this species from Europe.

30. *Autophila ligaminosa*?, Eversmann. Kandahar, in April.
The specimen seems to agree with Eversmann's description; but we do not possess the species in the Museum.

31. *Acidalia ornata*, Scopoli. Kandahar, October and November 1880.

32. *Sterrha sacraria*, Linn. Kandahar, October and November 1880.

33. *Pyralis farinalis*, Linn. Kandahar, in April 1881.

34. *Aglossa pinguinalis*, Linn. Quetta, in May: Kandahar, in April.
One shattered example (No. 29), taken at Kandahar in October, is referable to the variety *asiatica* of Erschoff.

35. *Pyrausta ostrinalis*, Hübner. One example of the broad-banded variety taken at Kandahar in November.

36. *Herbula cespitalis*, Denis. Kandahar, in November.

37. *Herbula meleagrisalis*, Walk. Kandahar, in November.

38. *Æschremon disparalis*, Herr.-Sch. Kandahar, in November.

39. *Scopula ferrugalis*, Hübn. Kandahar, in November.

The whole of the moths numbered (20) were sent in two pill-boxes, and having been shaken together throughout the whole distance from Kandahar to London, the only wonder is that there s any thing left to recognize them by. Lepidoptera, especially moths, cannot travel safely in this way. The only advantage of it is that it saves the collector a little trouble; but this is more than counterbalanced by the injury done to the specimens, all of which are necessarily more or less ruined as cabinet examples, and some, if not most, invariably rendered utterly unrecognizable. I think I can speak without prejudice upon this point with regard to the present collection, as here the orthodox envelopes considerably exceed the pill-boxes; it is, however, very unfortunate that the Microlepidoptera, which require more careful collecting than any others, are, as a rule, consigned to such unsafe receptacles—and not only so, but are usually accompanied by one or two examples of some common *Noctua*, as if in order to ensure their destruction.

40. *Stenopteryx hybridalis*, Hübner. Kandahar, October and November 1880, February 1881.

41. *Acrobasis ? imbella*, Walk. Kandahar, May 1880.

This is apparently an *Epischnia*; it agrees well with Walker's type, which, however, is said to be from Africa. Like many of these Microlepidoptera, it is probably a widely distributed species. The example is a good deal rubbed.

New Forms of Coryphodontidæ. By E. D. Cope.

The Wasatch beds of the Big-Horn basin have yielded several important additions to this family. Of eleven species found, two belong each to a new genus, and one is a novelty of the little-known genus *Metalophodon*. The characters of the genera of the family may be stated as follows:—

I. Two internal cusps of the last superior molar.
All the true molars with a developed posterior external V *Manteodon*.
II. One internal lobe of the last superior molar.

a. Last superior molar with posterior external cusp.
Anterior two molars with posterior external V .... *Ectacodon*.

aa. Last superior molar without external posterior cusp.
† Anterior two molars with posterior external V.
Astragalus transverse, with internal hook .... *Coryphodon*.
Astragalus subquadrate, without internal hook .... *Bathmodon*.
†† First superior molar only with posterior external V .. *Metalophodon*.

The type of *Manteodon* is the *M. subquadratus*, which was about the size of an ox. The characters of its superior molars are more

like those of Perissodactyles than are those of the other Coryphodontidæ. The type of *Ectacodon* is the *E. cinctus*, a species of about the dimensions of the last named. Its last superior molar is parallelogrammic, and has a cingulum all around it except on the external side. Of *Coryphodon* a species larger than any yet known has been abundantly found by Mr. Wortman, which I call, in a paper now passing through the press, *C. anax*. The new *Metalophodon* is as large as the *Ectacodon cinctus*, and has the second true molar more triangular and less oval than in the type *M. armatus*. The posterior external V of the last molar is reduced to a cone. I have called it *M. testis*.—*Amer. Nat.*, Jan. 1882.

An Anthropomorphous Lemur. By E. D. Cope.

The stock from which the true Quadrumana have been derived is supposed to have been the Lemurs; but no type of that suborder has hitherto been found which presents any near resemblance to either of the four families of monkeys. The two inferior families Cebidæ and Hapalidæ agree with most of the Lemuridæ in having three premolar teeth; but those of the upper jaw generally have well-developed internal lobes like the true molars, while most of those of the Lemurs have none. One group of Lemurs, the Indrisinæ, agree with the higher monkeys in having but two premolars; but these also are only one-lobed.

A nearly perfect cranium of a species of *Anaptomorphus*, Cope, shows that this genus had but two premolars in the superior series, as in the Indrisinæ, but that they are two-lobed, as in the Simiidæ and Hominidæ. Of these two families the Hominidæ is the one to which *Anaptomorphus* makes the nearest approach in dental characters. The canine is small, with a crown little longer than those of the premolars, and is not separated from the latter or from the incisors by any appreciable diastema. All but one of the superior incisors are lost from the specimen; but those of the lower jaw, which I discovered in 1872, were nearly erect as in man and the Simiidæ, and not procumbent as in most Lemurs. The cerebral hemispheres are remarkably large for an Eocene mammal, extending to between the middles of the orbits; the anterior parts, at least, are smooth. The cerebellum projected beyond the foramen magnum posteriorly, as in *Tarsius*. The orbits are large, approaching those of *Tarsius*, but are not so much walled in by a septum from the temporal fossa as in that genus. The superior molars have only one internal cusp.

The species, which I propose to call *Anaptomorphus homunculus*, has a wide palate much as in man; and the true molar teeth diminish in size posteriorly. The pterygoid and zygomatic fossæ are short and wide, and the petrous bone is large and inflated. The animal was nocturnal in its habits and was the size of a marmoset. The genus is nearer the hypothetical lemuroid ancestor of man than any yet discovered.—*Amer. Nat.*, Jan. 1882.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 52. APRIL 1882.

XXV.—*On certain Points in the Morphology of the Blastoidea, with Descriptions of some new Genera and Species.* By R. Etheridge, Jun., and P. Herbert Carpenter, M.A., Assistant Master at Eton College.

In the following pages we give some zoological descriptions of certain new genera and species of Blastoids which have come under our notice during the preparation of our joint memoir on the group. We propose in this memoir to limit our zoological work to the British species* only, though this is by no means the case with our morphological researches. These have led us to establish three new genera for some very singular types, which are described in the following pages, as they do not occur in this country. Their morphology will be discussed in full in our larger work, with the aid of the beautiful figures which are being prepared by our friends Messrs. C. Berjeau and P. Highley.

* A revision by competent hands of the American species of Blastoidea, like that of the Palæocrinoidea which is being so ably conducted by Messrs. Wachsmuth and Springer, is a very great desideratum. We have attempted in vain to work out the synonymy of many so-called species, owing to the want of material or of satisfactory descriptions and figures. The so-called *Codaster pulchellus* of Miller and Dyer (Journ. Cincinn. Soc. Nat. Hist. 1878, i. p. 35) is a case in point. There is no mention of hydrospiral slits in the specific diagnosis; nor are any shown in the figure; and we cannot help suspecting that this species represents a type very different from the original *Codaster* of M'Coy.

The basis of the classification which we have been led to adopt is the morphology of the hydrospires and of their external openings, the so-called spiracles. We find that the structure and distribution of these organs, together with the arrangement of the various elements composing the ambulacra, present characters of much systematic value.

Besides discovering various new generic types, both British and foreign, we have been led to form entirely new conceptions of some of the already existing genera, e. g. *Orophocrinus* (*Codonites*) and *Granatocrinus*; while we are able to give more precise definitions of *Troostocrinus* and of *Tricœlocrinus* than have hitherto been attempted.

In order to facilitate the comprehension of our specific descriptions, we give the following explanation of our terminology:—

The plates forming the calyx are the basals, radials or fork-pieces, and the deltoid pieces or orals *.

In *Codaster trilobatus* and in the more flat-topped American species of the genus the middle line of each oral is occupied by a more or less strongly marked ridge, the *oral ridge*. But in other species of *Codaster* and in the allied genus *Phænoschisma* this ridge is represented merely by an edge, from which the sides of the orals slope sharply downwards towards the ambulacra. This oral ridge is often very prominent at the central ends of the oral plates of *Pentremites*, so as more or less completely to separate the proximal ends of the passages which lead to the hydrospires of adjacent ambulacra.

In most Blastoids each radial is more or less fork-shaped, the handle of the fork being the *body* of the radial (which is separated from the basals by the *basiradial suture*), while the two prongs are the *limbs*. Between them is the *radial sinus*, which is occupied by the ambulacrum. This terminates in a more or less prominent "*lip*" on the upper edge of the body of the radial †.

Of the ambulacral structures which together fill up the

* As far as we can judge from various passages on pp. 12 and 13 of the 'Revision of the Palæocrinoidea' by Messrs. Wachsmuth and Springer, these authors seem to hold the same view as we do respecting the homology of the deltoid plates of the Blastoids with the "consolidating plates" of *Cyathocrinus* and the orals of the Pentacrinoid. But they make no definite statement to this effect.

† According to Messrs. Wachsmuth and Springer, "The lower part of the forked p[illegible] to the ambulacrum is the first radial—in *Blastoidocrinus*, the ol[illegible]wn Blastoid, the suture is visible—and the two sides of the fork, i[illegible] being interradial, form together a second radial" (Revision, [illegible]. We are sorry that we cannot agree with the American palæontologists in this view. We have unfortunately been unable to

radial sinus to a greater or less extent, the most important is the lancet-plate, which is excavated lengthways by the food-groove or ambulacrum proper. Upon or against it rest the *side plates* (pore-plates, *litt.*), which thus conceal it more or less completely; they are marked by minute pits, from which delicate grooves slant outwards towards the marginal pores. The latter are unconnected with the pinnules, which are arranged in a single or double row at the sides of the ambulacra. Their bases are apparently inserted into the above-mentioned pits or *pinnule-sockets*. In many species the distal edge of each pore is bounded by an *outer side plate* (supplemental pore-plate, *litt.*).

Between and more or less beneath the ambulacral fields are the interradial systems of lamellar tubes or *hydrospires*. The openings of these tubes directly on the ventral surface of the calyx, as in *Codaster* and *Phænoschisma*, are the *hydrospire-slits*. When these organs are concentrated beneath the ambulacra, the gap between the edge of the lancet-plate and the sides of the radial sinus is the *hydrospire-cleft*; it leads downwards into the *hydrospire-canal*, into which the hydrospires open by their slit-like upper ends. The hydrospire-cleft is much reduced and somewhat modified in the American species of *Orophocrinus*, but is widely open in the European species, especially in the Belgian ones, so as to expose some of the hydrospire-slits. In *Pentremites* proper it is also wide, but is bridged over by the side plates, between which are the *hydrospire-pores*. In *Granatocrinus* and *Schizoblastus* the inner wall of each hydrospire, *i. e.* that nearest the median line of the ambulacrum, is often carried upwards in certain parts of the ambulacra towards the ventral surface. Here it appears as a narrow plate-like edge between the lancet-plate and the side of the radial sinus. We have seen this *hydrospire-plate* very distinctly in *Schizoblastus melo* and in some of the British species of *Granatocrinus* (*G. ellipticus*, *G. derbiensis*). It bears a number of lateral processes, which meet corresponding ones upon the sides of the radial sinus, so that the hydrospire-cleft is represented merely by a row of pores alternating with

examine any specimens of *Blastoidocrinus*, which we only know from the figures of Billings and Schmidt. But we imagine the suture referred to by Wachsmuth and Springer to be the suture between the radials and orals (*oro-radial*), just as is shown in the hypothetical figure given by Billings ('Canadian Decades,' iv. p. 20), in whose interpretation of the calyx we entirely concur.

The form of the radials in the Mesozoic *Phyllocrinus* also indicates clearly that the fork-pieces of the Blastoids are primitively simple and undivided.

these processes. The hydrospire-pores, therefore, are formed without the intervention of any "pore-plates," which, for this and other reasons, we prefer to call "side plates."

The hydrospire-canals open externally by the *spiracles*, which are arranged at the summit, round the peristome; they may be either single (*Granatocrinus*) or paired (*Schizoblastus*, *Troostocrinus*). The spiracle or spiracles of the anal interradius may be confluent with the anal opening to form the *anal spiracle*.

In the better-preserved examples of many American Blastoids the mouth and peristome are concealed beneath a vault of minute irregular *summit-plates*, any definite arrangement of which is rarely traceable. This vault is sometimes continued down the ambulacra by a series of tiny *covering-plates*, which close in the food-grooves completely and convert them into tunnels just as in recent Crinoids. In none of the European Blastoids that we have seen has any indication of these structures been preserved.

As some considerable time must still elapse before the publication of our memoir, we wish to direct the attention of our fellow workers to one or two morphological points of interest.

In the ordinary *Pentremites* the hydrospiral tubes beneath the ambulacra extend along the entire length of the radial sinuses and communicate with the exterior by the marginal pores; but in the little *P. conoideus*, Hall, and *P. Koninckianus*, Hall, of the Warsaw limestone*, the hydrospiral tubes appear to be absent from the terminal third of the ambulacra. The sinus is considerably shorter on the inner than on the outer aspect of the radial; and the hydrospiral tubes end abruptly on the inner face of the plate, while the ambulacra extend much further towards the base of the calyx. Examples of both species are common with the shell filled up by a foraminiferal matrix, which thus forms a complete cast of its interior. This may be readily exposed by the removal of the shell; and it is then seen that the length of the ambulacra externally is greater than that of their internal casts. We have been unable to detect this peculiarity in any other species of *Pentremites*, but we think it very probable that our American colleagues may be more fortunate. Sections through the upper part of the calyx of *P. conoideus* show that it possesses hydrospires constructed on the ordinary *Pentremites* type. We have not, however, been able to obtain thoroughly satisfactory sections through the distal portions of the ambulacra; but from

* We cannot help suspecting the identity of these two so-called species.

what we have seen we think it possible that the hydrospiral tubes may be continued onto the ends of the ambulacra actually within the substance of the radial plates. This is at any rate the case throughout the greater part of the length of the ambulacra of *Tricælocrinus*, as we have found from sections of *T. Woodmani*, and from the examination of some large isolated radials which may, we think, possibly belong to *T. obliquatus*, Römer, sp. We take this species to be an entirely different one from that which was described later by Meek and Worthen under the same name.

Some valuable observations have been recently made by Messrs. Wachsmuth and Springer*, and by Dr. Hambach†, on the structure of the ambulacra of the Blastoids. This is more especially the case with regard to the subambulacral canals, which were first discovered by Rofe in *Granatocrinus ellipticus*, although their true nature was misinterpreted by him; for he believed the lancet-plate of this type (then referred to *Pentremites*) to consist of two lateral halves. As Hambach has pointed out with respect to other species, this does sometimes appear to be the case in worn specimens; for when the superficial portion of an ambulacrum has been removed the canal within the lancet-piece (which was seen, though misinterpreted, by Rofe) is not unfrequently exposed.

We have had the advantage of examining the whole of Mr. Rofe's collection, together with many specimens of *Granatocrinus Norwoodi*; and we are convinced that in *Granatocrinus*, as we define the genus ‡, there is but one subambulacral plate, the lancet-plate, which is pierced by a longitudinal canal. Messrs. Wachsmuth and Springer §, however, have described and figured the lancet-plate of *Pentremites* as imperforate, but as resting on an underlancet-plate which encloses a canal. Hambach ‖, on the other hand, describes the lancet-plate of typical *Pentremites* (*P. florealis*, *P. sulcatus*, *P. pyriformis*, &c.) as "pierced through the centre, in its whole length, by a very fine canal;" and we are inclined to think that he is right.

For although we agree with Wachsmuth and Springer in finding two subamulacral pieces in *Pentremites*, it seems to us more probable that the canal should be in the upper or lancet-

* "Revision of the Palæocrinoidea.—Parts i., ii.," Proc. Philad. Acad. 1879, 1881.

† "Contributions to the Anatomy of the Genus *Pentremites*, with Descriptions of new Species," Trans. St. Louis Acad. vol. iv. no. 1, pp. 145 160.

‡ See *posteà*.

§ Revision, part i. pl. iii. fig. 5. ‖ *Loc. cit.* p 149.

piece than in the lower and much thinner underlancet-piece, which we have also found in *Orophocrinus* (*Codonites*). The former corresponds to the perforate lancet-plate of *Granatocrinus*, which is the only subambulacral plate figured by Wachsmuth and Springer in *G. Norwoodi*; so that in this respect our observations appear to be in accordance with theirs.

According to Hambach* there is also "a longitudinal duct or vessel resting in the concave furrow of (*i. e.* beneath) the lancet-piece, and running from the apex of the ambulacral field to the summit, where it connects with a circular duct (œsophageal ring?) surrounding, on the interior side, the central orifice or *annulus centralis*."

But no mention is made by Hambach of the particular species in which this second canal occurs—though, so far as we can judge from the figure to which he refers in connexion with the above passage, he appears to be speaking of a *Pentremites*. In this case he must have seen canals both in the lancet-plate and in the underlancet-plate of this type; while Wachsmuth and Springer have only seen the latter, and we have only been able to make out the former, viz. that within the lancet-plate.

We believe it to have lodged the radial water-vessel. In *Pentremites* and *Orophocrinus*, which have two subambulacral plates, there is an opening at the proximal end of each ambulacrum, between the edges of two adjacent oral plates and the end of the underlancet-piece. It was first discovered and figured in *Pentremites* by Wachsmuth and Springer†, whose observations we are glad to be able to confirm. In *Granatocrinus* its distal side is incomplete, owing to the absence of an underlancet-piece. The vessel contained in the canal within the lancet-plate passed downwards through this opening on its way to join an oral ring. By careful grinding down of the summit of well-preserved specimens we have been able to demonstrate the presence of this organ and its connexion with the canals within the lancet-plates in the following species—*Pentremites pyriformis* and *P. burlingtonensis*, *Granatocrinus Norwoodi* and *G. ellipticus*, *Schizoblastus Sayi*, *Pentremitidea d'Archiaci*, *Orophocrinus inflatus* and *O. stelliformis*, and *Codaster trilobatus*. We venture to think that there can be but little doubt as to its being the water-vascular ring; but we cannot say whether it is identical with the "circular duct (œsophageal ring?)" described by Hambach ‡, as his state-

* *Loc. cit.* p. 151.

† Revision, part i. pl. iii. fig. 4.

‡ *Loc. cit.* p. 151.

ments about it are somewhat obscure. He says that he has been so fortunate as to obtain this structure entirely from a well-preserved specimen of *Pentremites* (i. e. *Granatocrinus*) *Norwoodi*, but that it is connected with the longitudinal duct or vessel beneath the lancet-piece. As, however, no second subambulacral canal has been detected in this species either by Messrs. Wachsmuth and Springer or by ourselves, we cannot help suspecting that Dr. Hambach must have seen the "longitudinal duct" in a *Pentremites* and the "circular duct" in *Granatocrinus Norwoodi*; but, in default of further information, we cannot absolutely identify this "circular duct" with the oral ring described above.

Messrs. Wachsmuth and Springer* have suggested that "the passage directly beneath the (ambulacral) field is probably the dorsal or axial canal (*i. e.* of the Crinoid arm), which by the inverted position of the arms became the inner instead of the outer passage." We are not sure that we quite understand Mr. Wachsmuth's theory of the ambulacra of the Blastoids. If they represent the inverted arms of a Crinoid, surely the food-grooves ought to be internal and not external. But if by this and similar expressions Mr. Wachsmuth means to describe a Blastoid ambulacrum as a Crinoid arm partially bent upon itself, we are disposed to agree with him.

It is probable enough that the Blastoids possessed a chambered organ and axial cords radiating from it, as in the Crinoids; but we do not think that these cords were lodged within the lancet-plates or underlancet-plates of the ambulacra, as supposed by Wachsmuth and Springer.

We propose to limit the name *Pentremites* to those Blastoids which resemble *P. Godoni*, Defr., *P. sulcatus*, Römer, and *P. pyriformis*, Say, in their structure and general appearance. The ambulacra are broad and petaloid; and in most species the side plates merely rest against the edges of the lancet-plate, without covering any part of it. The central end of each oral plate is flat and laterally expanded, with a more or less marked oral ridge in the middle line that divides it into two lateral halves. Each arm forms the floor of a passage leading along the lower part of the radial sinus over the upper ends of the hydrospire-slits. It is converted into a canal (the hydrospire-canal) by the side plates, which are wedged in between the lancet-plate and the side of the radial sinus. Those nearest the centre may either meet one another over the

* Revision, part ii. p. 33 (207).

oral ridge or abut against its sides. So far as we are able to judge from the material at our disposal, the American species of *Pentremites* are all similar to *P. Godoni*, and readily recognizable as belonging to this generic type as defined above. In 1857 Mr. Sydney S. Lyon * announced the discovery in certain species of *Pentremites* of three small pieces situated below the basals, which he considered to represent the true basals; and he emended the formula of the genus accordingly. This view was afterwards supported in part by Messrs. Meek and Worthen†, who bore out Lyon's statement as to the presence of a dicyclic base in the calyx of *Pentremites*, but regarded the lower series as supplementary basals rather than as true basals.

We have given great attention to this important question, and must confess that up to the present time we have quite failed to detect any plates which could be regarded either as supplemental or as under basals. We cannot help thinking that the plates so regarded are nothing more than the uppermost stem-joint more or less modified. Indeed it appears to us that Messrs. Meek and Worthen were themselves not altogether clear on the subject; for in the description of their figures of *Orophocrinus* (*Codonites*) *stelliformis*, O. & S., they say:—"Fig. 5, *a*. A side view of a small specimen, showing the part under the base that has been, by some, supposed to be in the *Pentremites* the true basal pieces, to be really only some six of the upper joints of the column, anchylosed together and to the base" ‡.

In the meantime we wish it to be distinctly understood that we do not commit ourselves to either view, but leave the question an open one for further consideration and investigation.

Genus Pentremitidea, d'Orbigny, 1849 (emend. E & C. 1882.)

Pentremitidea, d'Orbigny, Prodrome de Pal. 1849, i. p. 102.
Pentremitidæa, d'Orbigny, Cours Elémentaire, &c. p. 139.

Gen. char. Calyx varying in outline from elongately clavate-pyramidal to pentagonal obpyriform; summit truncate or convex; base usually long and conical. Number and disposition of the plates similar to those of *Pentremites* proper, but the orals inconspicuous, confined to the summit, and never visible in a side view; radial plates always strongly lobate.

* D. D. Owen's 3rd Report Geol. Survey, Kentucky, 1857, p. 468.
† Illinois Geol. Survey Report, 1873, v. p. 464 (note).
‡ *Loc. cit.* v. expl. of pl. ix. fig. 5.

Ambulacra narrow in all but one species, not greatly depressed within the radial sinuses. Side plates lying actually on the lancet-plate, and usually hiding it from view. Spiracles usually large, and, as well as the hydrospires, constructed like those of *Pentremites*. Anal aperture confluent with the two spiracles at its sides, to form a common anal spiracle.

Obs. The name *Pentremitidea** was proposed by D'Orbigny in 1849 for two Devonian Blastoids from Spain, which he believed to be peculiar in having a calyx composed of but two rows of plates, the basals and radials. Römer† showed, however, that the two species in question, *P. Pailletti*, d'A. & de Vern., and *P. Schultzii*, d'A. & de Vern., are provided, like other Blastoids, with the third row of plates or orals. On these grounds, therefore, *Pentremitidea* has not been adopted by later writers on this interesting class. It appears, however, that *P. Pailletti*, in common with a limited number of other forms, possesses peculiarities of calicular structure which separate it at once from *Pentremites* as understood by us; and we propose, in consequence, to rehabilitate d'Orbigny's name for such species.

It may be contended that an entirely new name would have been preferable in this case. From the fact, however, that d'Orbigny's types, although unknown to him, happen to possess the chief points of structure on which we propose to separate the genus from *Pentremites*, we prefer to adopt his name rather than unnecessarily burden science with a new one.

Pentremitidea has a more slender and elongate calyx than *Pentremites*, or else one approaching in outline to that of *Orophocrinus*. These apparently dissimilar forms possess, in common, a slender base, narrow ambulacra, and oral plates entirely limited to the summit. The side plates of the ambulacra lie directly on, and in a great measure cover, the lancet-plates, except in one species. Such characters are diametrically opposed to those of *Pentremites*, when restricted (as we

* It may be well to state here that, in a paper read at the York meeting of the British Association in September 1881, one of us referred to the genus *Pentremitidea* and to *P. Pailletti* as having the hydrospiral slits more or less concealed by the ambulacra, but partially visible at their sides. We have since found, however, that a species presenting these characters (which will be described under the generic name *Phænoschisma*) has been hitherto confounded with the true *Pentremitidea Pailletti*, from the same locality, which it somewhat closely resembles in external form.

This fact seems to have escaped the notice of the donors of these fossils to the national collection, both types sharing in a common label—"*Pentremitidea Pailletti.*"

† 'Monographie der Blastoideen,' Berlin, 1852, p. 49.

propose that this name should be) to such species as *P. Godoni*, Defrance, sp., *P. sulcatus*, Römer, and *P. pyriformis*, Say, &c.

The variability of external form is perhaps as marked in this genus as in any member of the Blastoidea. Two distinct types are met with, the pyriform and clavate. Starting with the type species, *P. Pailletti*, representing the former, we have in the one direction a gradual transition through *P. lusitanica* to the much more elongated calyx of *P. Schultzii*, with its truncated summit and expanded ambulacra. In the other direction we observe a gradual change in outline through *P. eifelensis* to *P. clavata* and *P. acutangula*, and so on to the Orophocrinoid species *P. angulata* and *P. similis*.

The amount of truncation of the summit also varies considerably. In *P. Schultzii* we see the limit of variability, the summit being broad, flattened, and extending across the whole width of the calyx. The width of the summit is decidedly less in *P. Pailletti*, again smaller in *P. lusitanica*, and still more so in the aberrant *P. angulata* and *P. similis*. Similarly, the broader the summit the wider the ambulacra; hence we meet with the greatest development of this kind in *P. Schultzii*, the ambulacra gradually becoming narrower in *P. lusitanica* and *P. Pailletti*, and reaching the limit in the same two forms mentioned above.

As regards the more intimate structure of the ambulacra, we may describe three examples. In the first of these, *P. Schultzii*, the ambulacra are very wide, flattened, or a little concave, and more or less deltoid in form. The lancet-plate elongately petaloid, more markedly so than in most Blastoids. The side plates abutting against it are fourteen on each side, narrow, and oblong. The outer side plates are very small, placed quite at the extremities of the side plates, and nearly on the same level with them. In the clavate and pyriform types the structure is more or less similar, as, for instance, in *P. clavata* and *P. lusitanica*. The side plates do not reach the edges of the radial forks; but the intervening spaces are bridged over by the outer side plates, alternating with the pores, which are very large.

We are acquainted with the hydrospires of only two species, *P. Schultzii* and *P. Pailletti*, in both of which these organs are eight in number on each side of the ambulacra.

One of the most important features in *Pentremitidea* is given by the oral plates, which, in consequence of their very small size and close connexion with the summit, afford one of the most stable characters of the genus. In most of the species they are quite inconspicuous, and cannot be distinguished except as forming the dividing septum of the spira-

cles. They are visible in *P. lusitanica*, and again in *P. Schultzii*, but are of a much more elongated form in the latter species.

The species we propose to place in *Pentremitidea* are the following:—

Pentremites Pailletti, d'Orb. Devonian; Asturias.
P. Schultzii, d'Orb. Ditto.
P. acutangulus, Schultze. Devonian; Eifel.
P. clavatus, Schultze. Ditto.
P. eifelensis, F. Römer. Ditto.
Pentremitidea lusitanica, nobis. Devonian; Spain (? Asturias).
P. angulata, nobis. Ditto.
P. similis, nobis. Devonian; Eifel.

Pentremitidea appears to be essentially a Devonian genus, being altogether unrepresented in the Carboniferous rocks. Half its known species occur in the Eifel, and the rest in the Asturias. The fine collection of Mr. Wachsmuth contains an unnamed Blastoid from the Upper Silurian or Lower Devonian of Charleston, Indiana, which we cannot distinguish from the Spanish *Pentremitidea Pailletti*. So far as we know at present, this is the only species of Blastoid which is common to Europe and America. We think it very probable that some of the more obscure American species of *Pentremites* will also have to be referred to this genus.

Pentremitidea lusitanica, sp. nov.

Sp. char. Calyx clavate-pyriform, elongated, expanding gradually upwards; peristome truncate; base elongate and pointed. Basal plates only a trifle shorter than the radials, forming an elongated cup, the lower portion of each plate bearing a strong central ridge, which assists in the ornamentation. Radial plates rather narrow, elongated, and arched from the lip downwards along the body. Three impressed lines diverge from the lip, one to each infero-lateral angle and one along the middle line. Radial sinuses with sharp erect margins, making an angle of about 134° with the truncated peristome; lips a little thickened and simply rounded. Ambulacra elongately petaloid; lancet-plates broad, almost wholly filling up the radial sinuses; side plates large and oblong, their outer margins rounded, about fifteen in number on each side the ambulacra; outer side plates narrow, bent down at a much greater angle than the side plates. Surface ornamented by fine close concentric raised lines parallel to the

margins of the various plates, those on the lower portions of the basal plates being of a peculiar V-shaped pattern.

Obs. This is a well-marked species, which may be at once distinguished from *Pentremitidea clavata*, Schultze, *P. acutangula*, Schultze, *P. Schultzii*, de Verneuil, and the two species next to be described, by the outline of the calyx. It differs sharply from *P. Pailletti*, the type of the genus, in the lobation of the radials, the smaller angle of inclination of the radial sinuses, and in their shorter length. *P. lusitanica* to a certain extent resembles *P. eifelensis*, F. Römer, of which Schultze has given a figure. Indeed, this species is its closest ally; but here, again, the radial angle is quite different, and gives to the Eifel species the appearance of possessing a longer and more curved sinus in each radial, and a very much less breadth across the peristome.

Loc. and Horizon. Asturias, Spain; Devonian (Mus. Nat. History).

Pentremitidea angulata, sp. nov.

Sp. char. Calyx pentagonal obpyriform, enlarging upwards to the distal extremities of the ambulacra, which are nearly equatorial; section decagonal, without re-entering angles between the ambulacra; summit small. Basal plates a little less than half the length of the radials, forming a strongly triangular cup, with three prominent angles, one corresponding to an interradius, the two others opposite ambulacra; surface of the plates between the angles hollowed out; base of attachment for the column triangular. Radial plates elongated, their surfaces in two planes which cut one another at the equatorial line of the calyx: the upper, sloping away to the summit, consists of the limbs; the lower, or the body below the radial lips, extends to the basiradial sutures and is hollowed out; a median ridge passes downwards from each lip to the basiradial suture, whilst the angle produced by the union of the two planes forms the greatest periphery or equator of the calyx. The lateral margins of the radial limbs are not placed in depressions, but the line of union of every two adjacent limbs forms a prominent angle of the calyx. Radial sinuses very narrow and long, with prominent lips. Oral plates quite apical. Ambulacra long and very narrow, maintaining almost the same width throughout their whole course; lancet-plates nearly as wide as the sinuses; side plates about twenty in number on each side of an ambulacrum, short but broad. Spiracles close round the mouth; anal spiracle with a prominent outer margin. Surface ornamented in the usual way.

Obs. This is a very interesting and peculiar species, representing, with that next to be described, one extreme type of the genus. The form of the calyx and the angulation of the radial plates will readily separate *P. angulata* from all the described species. The abruptly clavate outline indicates an approach to *P. clavata*, Schultze; but no other resemblance is observable; whilst with *P. similis* (nobis), although after the same general type, no definite comparison can be made.

There is a curious resemblance in external form between *Pentremitidea angulata* and *Phænoschisma caryophyllatum*, de Koninck sp., a member of a distinct genus that differs altogether from *Pentremitidea* in its other characters. *Pentremitidea angulata* is the aberrant species of the one genus as *Phænoschisma caryophyllatum* is of the other. Both agree to a certain extent in outward form, and differ in this particular from the other species of their respective genera.

Loc. and Horizon. Asturias, Spain; Devonian (Mus. Nat. History).

Pentremitidea similis, sp. nov.

Sp. char. Calyx pentagonal obpyriform, expanding rapidly upwards above the basiradial sutures; section strongly pentagonal, the greatest periphery being nearer the summit than the base; the latter is sharp, and the former depressed. Basals forming a small slightly expanded cup. Radials arched, broad at their bases, expanding very slightly upwards to the level of the lips, the limbs then rapidly decreasing to the summit, and forming strong projecting lobes around the calyx; sinuses very narrow, straight, the angle about 134°. Orals almost invisible. Ambulacra narrow.

Obs. Although we are only able to give a limited definition of this species, it is nevertheless sufficient to show how clearly distinct it is from any other *Pentremitidea.* On the other hand the resemblance of the calyx in general form to that of an *Orophocrinus*, especially that of the typical species *O. stelliformis*, is very remarkable; but here, of course, the resemblance ceases. The radial angle, the length of the ambulacra, and the greater amount of calycular surface between their distal extremities and the base of the calyx in *P. similis* separate it from *P. clavata*, Schultze, to which it is nearly related. The form of the radial plates in *P. angulata*, irrespective of other characters, at once separates the latter from *P. similis.* The Messrs. Sandberger have described a peculiar form from the Rhenish Devonian rocks, which is much too depressed a species to be confounded with ours, even supposing the former to be a *Pentremitidea.*

Loc. and Horizon. Eifel; Devonian (Mus. Nat. History).

Genus Phænoschisma, gen. nov.

Gen. char. Calyx elongately clavate or obclavate; the number and disposition of the plates and general composition of the ambulacra similar to those of *Pentremites*. The oral plates are very small, inconspicuous, and always confined to the summit, where they are either horizontally placed or inclined inwards. The radials bear three more or less distinct folds diverging from the lips; and the two contiguous limbs forming the anal side are more or less abortive. Radial sinuses wide and deep, generally with steep sides. Spiracles as distinct apertures absent, the hydrospires opening externally by a series of elongated slits with intervening ridges, distributed in subparallel series on the sloping sides of all the radial sinuses; they are either both radial and oral or only radial in composition; and being only partially covered by the ambulacral plates, their distal ends (or even the entire length of some) are visible on the sides of the radial sinuses. Lancet-plate concealed by the side plates (in all but one species); outer side plates very small. Anus a separate opening, and further removed from the summit-centre than in *Pentremites*. Column, when compared with the size of the calyx, larger than in the last-named genus.

Obs. We have established *Phænoschisma* for a small number of interesting species hitherto included in *Pentremites*. The late Mr. E. Billings, in a remarkable article "On the Structure of the Crinoidea, Cystoidea, and Blastoidea" *, referred as follows to the peculiar structure of the ambulacra in *Pentremites caryophyllatus*, de Koninck †:—"The ends of the fissures of the hydrospires are seen along the sides of the angular ridges, which extend from the apices of the pyramids‡ to the angles between the arms. I do not think that such species can be referred to *Pentremites*; and if I had specimens before me instead of figures only, I would most probably institute a new genus for their reception."

It affords us much pleasure to adopt the suggestion of Mr. Billings by proposing the name *Phænoschisma* for Blastoids possessing these characters. They differ from *Pentremites* in four essential points of structure—the absence of true spiracles around the peristome, the presence of a distinct anal

* Amer. Journ. Sc. 1869, xlviii. p. 80.

† Billings seems to have merely copied De Koninck's figure of this species (*l. c.* p. 79, fig. 11), which is erroneous in that the direction of these fissures is given from below the ambulacra outwards, whereas in reality they are subparallel to the latter (see 'Crinoïdes du Terr. Carb. Belgique,' 1854, t. 7. f. 3, *b*).

‡ *I. e.* the oral plates (= deltoids of authors).

orifice, the oral plates being of inconspicuous size and confined to the summit, and the marked change in the disposition of the hydrospires and their method of opening externally.

In *Pentremites* it will be remembered the hydrospires are situated internally immediately right and left of each ambulacrum, then communicate above with the common hydrospire-canal, which opens externally by means of the pores ranged along each side of the ambulacra, and also through the spiracles at the apex. But no part of the hydrospiral apparatus is visible externally, the whole of it being concealed by the lancet-plate and side plates of the wide ambulacra.

In *Phænoschisma*, on the other hand, the radial sinuses are much wider and deeper than are those of *Pentremites*. The lancet-, side, and outer side plates fail to fill them completely, and are confined, generally speaking, to the bottom of the cavity of each sinus. The spaces so left uncovered, consisting of the sides of the sinuses, formed by the inturned edges of the radials and orals, but chiefly, and sometimes wholly, of the former, are occupied by a variable number of subparallel slits, which are in fact the openings of the hydrospires exposed to view. The slits near the bottom of the cavities are the longest and most completely covered, and those near the top of each sinus the shortest, the outer ones being sometimes visible throughout their entire length. The number of the slits exposed and the amount of their exposure entirely depend on the relative size of the side and outer side plates, and how far they extend in a lateral direction towards the sides of the sinuses. In this way the hydrospiral canal and true spiracles are dispensed with, the hydrospires communicating directly with the exterior without the aid of any intermediate orifices.

Phænoschisma is allied to the genus *Codaster*, M'Coy, both in the structure of its respiratory organs and also in the absence of ambulacral pores. It differs, however, from M'Coy's genus in the partial exposure only of the hydrospiral slits, and in their presence in the anal interradius, as well as in the four others. *Phænoschisma*, in consequence, possesses ten groups of hydrospires, whilst *Codaster* has only eight. Further, the former genus has relatively smaller orals than the latter, and it may possess outer side plates to the ambulacra.

Phænoschisma differs from *Orophocrinus* in the fact that the ambulacra are nowhere in contact with the sides of the radial sinuses, as in Von Seebach's genus, and that the oral plates never show in a side view of the calyx. To *Pentremitidea* *Phænoschisma* stands in the same relation that it does to

Pentremites, except as regards the oral plates, which resemble those of the former genus.

Spiracles, in the true sense of the word, do not exist in *Phænoschisma*. At the same time there are visible in *Ph. acutum*, Phill. sp., some small openings at the central ends of the ambulacra, which may serve as such, and coexist with the exposed hydrospire-slits. They are imperceptible in *Ph. Archiaci*, nobis, but are present to some extent in *Ph. caryophyllatum*, de Kon. sp.

The species vary considerably in the amount of exposure of the hydrospiral slits. In *Ph. acutum* one slit is usually visible for the greater part of its length, though it may sometimes be entirely concealed upon one side of an ambulacrum. *Ph. caryophyllatum* shows one uncovered slit and the distal ends of four or five others, while in *Ph. Archiaci* two slits are completely visible and four others partially so.

Finally, the exposure is carried to the greatest extent in *Ph. Verneuili*, nobis, which has the majority of its slits uncovered.

So far as the genus is at present known to us, the form, with one exception, is elongately pyriform. The abnormal species is *Ph. caryophyllatum*, which is a shorter, rounder, and more depressed species than any of the others. Similarly the ambulacra are narrow in all but this species, where they become to a certain extent petaloid. Again, the side plates, except in the same species, lie actually on the lancet-plate, and not against it as in *Pentremites*. This is a feature which is very characteristic of the genus *Granatocrinus*, and is again seen in *Pentremitidea*.

The retention of the small and inconspicuous orals at the summit of the calyx, so that they are invisible in a side view, is a very marked feature in *Phænoschisma*, and a constant character throughout the genus. They are of larger size in the aberrant *Ph. caryophyllatum* than in any of the other species. We have succeeded in exposing the watervascular ring of this genus, and find that it is of essentially the same character as that of *Pentremites*, *Orophocrinus*, and *Granatocrinus*. It is perhaps a little smaller, and the canals leading from the apertures in the lancet-plate rather longer.

The anal aperture varies in its character according to the species. For instance, in *Ph. Archiaci* the contiguous limbs of adjacent radials forming the anal interradius are shortened and truncated, so as partially to surround the anus. In *Ph. acutum*, Phill. sp., on the other hand, the cristiform aspect of the other interradii is in no way altered in the anal interradius, and the surface of the oro-anal plate is hollowed out for the partial reception of the aperture.

We propose to include the following species in the genus *Phænoschisma*:—

Pentremites acutus, Phillips. Carboniferous Limestone, England.
Pentremites caryophyllatus, de Koninck. Carboniferous Limestone, Belgium.
Phænoschisma Verneuili, nobis. Devonian, Spain.
Phænoschisma Archiaci, nobis. Devonian, Spain.

Our researches have not disclosed the existence of the genus during Silurian times; but it appears to have made its first appearance during the Devonian period, as represented by the Devonian rocks of Asturias, Spain. *Phænoschisma* reappears in the Carboniferous Limestone of England and Belgium, but, so far as we can ascertain, is unrepresented in the American Palæozoic rocks, unless *Pentremites kentuckiensis*, Shumard *, from the Subcarboniferous rocks near Louisville, Kentucky, be referable to this interesting type.

Phænoschisma Verneuili, sp. nov.

Sp. char. Calyx elongately pyramidal, with a sharp-pointed base and a hollow summit excavated in the direction of the rays. The ambulacra are separated by strong interradial processes, each of which is formed by the union of the adjacent limbs of two contiguous radials. Section distinctly pentagonal at the distal ends of the ambulacra. Basal plates forming an elongated cup about two thirds the length of the radials and a little longer than the bodies of those plates. Radial plates large, arched, with prominent lips, from which three folds diverge downwards; limbs long and projecting above the summit, except the two contiguous ones forming the anal interradius, which are flattened or depressed; sinuses very wide and deep, with high sloping sides. The four similar oral plates very small, but the anal-oral larger and diamond-shaped. Ambulacra linear, scarcely increasing in width; lancet-plate narrow, entirely concealed; outer side-plates very small and triangular; side plates from twenty to twenty-five, apparently oblong; hydrospire-slits from twelve to eighteen, crowded together. Mouth small; anus roundly triangular. Surface ornamented by sharp striæ parallel to the margins of the plates. A distinct border follows the margin of each radial plate, defined by a faint groove.

Obs. Phænoschisma Verneuili needs no comparison with other species of the genus, except with *Ph. acutum*, Phill. sp.,

* Trans. St. Louis Acad. i. p. 239, t. ix. f. 13.

from which it differs in size, in the elevated nature of its interradii, and in its greater number of hydrospiral slits. As regards form, *Ph. Verneuili* represents one extreme modification of the genus, and *Ph. caryophyllatum* another.

Loc. and Horizon. Asturias, Spain; Devonian (Mus. Nat. History).

Phænoschisma Archiaci, sp. nov.

Sp. char. Calyx clavate, becoming more pentalobate with age. The angles of the pentagon correspond to the distal ends of the ambulacra; and its sides are concave, not straight. Base long and sharp; oro-anal surface truncate. Basal plates very long and slender, longer than the radials, expanding very gradually into a small cup, the surfaces ornamented with concentric striæ having two different directions. Radial plates small, lobate about the lips, projecting somewhat upward, and obliquely truncate on their upper margins; those of the anal interradius are a little flattened. Surface somewhat angular in the middle line from the lips down to the basiradial suture. Sinuses short, having a radial angle of about 130°, and somewhat petaloid. Orals confined to the immediate neighbourhood of the mouth. Ambulacra short, a little petaloid; lancet-plate lanceolate, narrow, deeply triangular in section; side plates few, six to eight or nine, oblong; outer side plates triangular, very small. Hydrospire-slits six on each side, the sixth partially covered by the lancet-plate, two only being entirely exposed when the side plates are in position. Hydrospires in the form of long, pendent, slender sacs. Mouth small; anus roundly triangular. Surface of plates ornamented with concentric striæ.

Obs. Ph. Archiaci does not possess the elevated interradial spaces of *Ph. Verneuili*, and is thereby distinguished from it, apart from their differences in other characters. The outline of the calyx generally, the form of the anal interradius, and the general features of the ambulacra and hydrospire-slits separate it from *Ph. acutum*. It is also unlike *Ph. caryophyllatum*, but may be said to be a transitional form between the two former species and the latter. The ornamentation of the basal plates is quite similar to that of a species of *Pentremitidea* (*P. lusitanica*), and might lead to a confusion of the two species should the generic characters not be properly attended to.

Genus Codaster, M'Coy, 1849.

Codaster, M'Coy, Ann. & Mag. Nat. Hist. 1849, iii. p. 250.

Codaster vel *Codonaster*, M'Coy, Brit. Pal. Foss. 1851, fasc. i. p. 122, t. 3 D (expl.).
Codonaster, F. Römer, Wiegmann's Archiv für Naturgeschichte, 1851, xvii. Bd. i. p. 381.

Obs. Without absolutely redefining *Codaster*, we may say that, on the whole, we accept M'Coy's definition as accurately describing the characters of the genus. Some few emendations and additions are necessary. For instance, the radial plates (M'Coy's suprabasals) not only "reach to the truncated summit," but they are more or less inturned at the edge of the summit towards the apex, so as to form limbs in the usual way, which enclose narrow radial sinuses like those of other Blastoids. Oral plates also are present, appearing as diamond-shaped plates on the truncated summit in well-preserved specimens. Four of these bear along their median line the "thick, rapidly tapering ridges" of M'Coy, which are in no way an abnormal structure, but only represent the crests of the orals (and sometimes the combined orals and radials) of other genera.

So far as our own researches have gone, we have been quite unable to detect the supplemental basals described by Mr. S. S. Lyon * in any species examined by us. The "rough parallel striæ" and the "impressed lines" between them of M'Coy appear to have been a great stumbling-block to the earlier investigators of this genus. Lyon remarks, "the depressed triangular intervening spaces are filled with seven or more thin pieces lying parallel to the pseudambulacral fields, articulating with the summit of the second radials, and the prominent ridge lying between the pseudambulacræ. These pieces were evidently capable of being compressed or depressed "†. It is almost needless to observe that the view ascribing to the hydrospiral grooves the nature of distinct pieces is no longer tenable.

In 1861 Prof. James Hall observed that the striated interradial spaces of his *Codaster Whitei* "appear to be composed of separate linear plates like the pectinated rhombs of the Cystideans; and in one place, where broken through, they are seen to be discontinued almost to the inner face of the substance, giving the appearance of numerous thin parallel lamellæ"‡. These remarks may be said to have foreshadowed the important discoveries which were afterwards made by the late Mr. Rofe, and published in 1865. He found, by cutting

* D. D. Owen's 3rd Kentucky Report, p. 493.
† *Loc. cit.* p. 494.
‡ Boston Journ. Nat. History, 1861, vii. no. 2, p. 327.

thin sections for the microscope, "that the ridges on the striated interradial surfaces are the tops of a series of folds of a thin test or membrane, the alternate folds being so united at the ends as to form a series of long but very narrow sacs;" and he further suggested their respiratory character *. These organs were called hydrospires by Billings †, who has confirmed Rofe's observations; and after a careful examination of Rofe's material, we are glad to be able to add our own testimony as to the accuracy of his descriptions. The full complement of hydrospires is deficient, as Mr. Billings has very justly pointed out, by two sets, in consequence of one interradius being completely occupied by the large vent ‡; there are therefore eight sets, instead of ten as in the closely-allied *Phænoschisma*, *Pentremites*, and other genera. Owing to the direct communication of the hydrospire-slits with the exterior, there are no hydrospire-canals or spiracles.

From an examination of the British *Codasters* we can confirm the description given by Billings of the structure of the ambulacra in a Canadian species §. As there are no hydrospire-canals, there are no pores; and we doubt whether outer side plates are present in all species. Although we agree with most of Billings's descriptions of structural characters, we cannot accept his deductions from them as to the Cystid affinities of *Codaster*, a point which we shall touch upon later.

Messrs. Meek and Worthen have suggested ‖ that the puncta in the hydrospiral grooves communicate directly with the hydrospires, and represent the spiracles of other Blastoids. We cannot assent to this; nor are we at all clear that puncta exist in the impressed lines on the interradial areas of *Codaster*. M'Coy only described them with doubt; and no definite evidence has presented itself amongst the large number of British specimens of *Codaster* examined by us. Neither do we see the slightest reason to suppose that any portion of the hydrospire-apparatus was capable of movement, as suggested by the following remark of S. S. Lyon ¶:—"these pieces were evidently capable of being compressed and depressed."

The number of hydrospires varies considerably according to species. In M'Coy's *C. trilobatus* there are as many as

* Geol. Mag. 1865, ii. p. 251.

† Amer. Journ. Sc. 1869, xlviii. pp. 78-80.

‡ *Loc. cit.* 1870, xlix. p. 54.

§ *Loc. cit.* 1869, xlviii. p. 79.

‖ Proc. Acad. Nat. Sci. Philad. 1869, p. 84 (note).

¶ D. D. Owen's 3rd Report Geol. Survey of Kentucky, 1857, p. 494.

ten exposed in each area, or sometimes nine exposed and one partly concealed under the side of the adjacent ambulacrum. In other varieties of this species we meet with seven grooves or slits; and some may be seen with eight. In *C. acutus*, M'Coy, the number varies from three in the young condition to four, five, or six, according to the state of growth; but invariably one and sometimes one and a half are concealed, as in *C. trilobatus**. The hydrospire-slits in *C. pyramidatus*, Shumard, are six or seven in number, and seven or more in *C. alternatus*, Lyon. Lastly, in *C. Hindei*, nobis, there are seven apertures on each of the interradial spaces, one of which is more or less covered by the edge of the ambulacrum.

We see no reason to doubt that *Codaster* possessed the usual plated integument over the central aperture, as noticed by Mr. Billings †; but we have not been fortunate enough to discover it in any of our British specimens. The outline of the ambulacra varies but little. They are lanceolate in the British species, narrow and linear in *C. americanus*, narrow in *C. Whitei*, and petaloid in *C. pyramidatus*. The side plates do not cover the lancet-plate entirely, but rest on its sides, leaving about a third of its width uncovered. The sides of the lancet-plate are always deeply notched for the reception of the side-plates. The latter vary in number according to species; the British form possesses from six to ten on each side. *C. Whitei* has twenty-three or twenty-four ‡, whilst in *C. pyramidatus* there are twenty-two. We have not been able to detect outer side plates in the British species; and, as before mentioned, there are no pores; but each side plate carries a large socket for the reception of the appendages. The structure of the ambulacra in the American *Codasters* appears to be somewhat different. Lyon described the ambulacra of *C. alternatus* as "divided into four equal parts by three indented lines." Shumard described and figured the same thing in *C. pyramidatus*; and the structure of our *C. Hindei* is identical. The middle one of the three indented lines is the ambulacral groove, the two lateral ones bounding the side plates, which here lie on and almost entirely conceal the lancet-plate. The outer side plates are placed outside the lateral "indented lines," and project somewhat upwards; pores were not observed.

The interradial or oral ridges present some marked pecu-

* These two so-called species appear to graduate into one another; and some doubt if they can be regarded as distinct.

† *Loc. cit.* 1870, xlix. p. 54.

‡ Boston Journ. Nat. Hist. 1861, vii. no. 2, p. 327.

liarities; and the outline of the summit depends very considerably upon the flatness or arched character of the plates which bear these ridges. In *C. pyramidatus* they are flat, broad, and lanceolate, sharp in *C. Whitei*, and barely separating the slits of adjacent interradii at their outer extremities. But they become wider towards the mouth; and their proximal ends in this species and in *C. alternatus* bear small tubercles. In the latter species the oral ridges project somewhat above the general surface of the summit and slope inwards; but in *C. pyramidatus* they are inclined outwards, and to a certain extent also in *C. Hindei*.

The radial sinuses are short in all the species, and usually triangular. The anus is either rhombic, as in *C. pyramidatus* and *C. trilobatus*, or ovate (*C. alternatus*). The column appears to have been circular and very small.

Codaster differs from *Pentremites* and *Granatocrinus* in the greater distinctness of the summit from the remainder of the calyx, in the absence of spiracles and the presence of the large interradial anal opening, in the reduction in the number of the groups of hydrospires from ten to eight, owing to their absence from the anal interradius, in this opening directly to the exterior instead of being withdrawn beneath the ambulacra, and, lastly, in the absence of hydrospire-pores. The same characters also separate *Codaster* from *Pentremitidea*, *Schizoblastus*, *Tricœlocrinus*, and *Troostocrinus*. There is a nearer affinity existing between *Codaster* and *Phænoschisma* in the exposure of the hydrospiral slits on the surface of the calyx, and in the absence of definite spiracles; but in the latter genus the anal interradius is occupied by hydrospires, and the outline of the calyx in the two genera is quite different.

Codaster was established by M'Coy as a Blastoid; but Mr. Rofe * regarded it as a connecting-link between the Crinoidea and Cystoidea, *Pentremites* being more closely allied to the former, and *Codaster* to the latter. On the other hand, Billings † definitely referred it to the Cystoidea, because there is no connexion between its hydrospires and the cavities of the pinnulæ borne on the ambulacra, such as he assumed to exist in *Pentremites*.

We cannot learn that any other palæontologist but Prof. Zittel ‡ has definitely adopted this view, which is far from commending itself to us. If *Codaster* is a Cystoid, so are

* Geol. Mag. 1865, ii. p. 251.
† Amer. Journ. Sc. 1869, xlviii. p. 80.
‡ Handb. d. Pal. 1880, Bd. i. Abth. 1, p. 424.

Orophocrinus and *Phænoschisma*, which are also devoid of pores at the sides of the ambulacra leading into the hydrospires. But *Codaster* is a true Blastoid in every respect; and we think that Billings was led to this erroneous conception by his not having emancipated himself from the old doctrine of the pinnules of *Pentremites* being placed directly over the hydrospire-pores bordering the ambulacra, a theory now abandoned by all the more prominent writers on the Blastoidea.

The following species are comprised in the genus *Codaster*:—

- **Codaster acutus*, M'Coy. Carboniferous Limestone, England.
- *C. alternatus*, Lyon. Upper Helderberg group (Lower Devonian), Kentucky.
- *C. americanus*, Shumard. Upper Helderberg group (Lower Devonian), Kentucky.
- *C. pyramidatus*, Shumard. Upper Helderberg group (Lower Devonian), Kentucky.
- **C. trilobatus*, M'Coy. Carboniferous Limestone, England.
- *C. Whitei*, Hall. Burlington group (Subcarboniferous).

Codaster thus appeared first in the Lower Devonian of North America, and was represented by three species. It extended into the Carboniferous Limestone of the same continent and of the British Islands; but we believe it to be unknown in the Upper Palæozoic rocks of the continent of Europe.

If the Blastoid described by Messrs. Miller and Dyer as *Codaster pulchellus* † belongs to this genus, which we very much doubt, *Codaster* will then range back in time as far as the Niagara group (Wenlock).

Codaster Hindei, sp. nov.

Sp. char. Calyx obtusely conoid and wall-sided; summit more or less truncated and decagonal; oral crests of nearly equal length with the ambulacra. Basal and radial plates about equal in length, the latter convex, most sharply so in the middle line; but the limbs are placed at such an angle that the union of every two produces a perfectly flat side to the calyx; sutures not marked by any depression; sinus rhombic. Four regular oral plates rhomboid and arched, with a narrow sharp oral ridge, either in the same general plane with the summit or inclined very slightly outwards,

* Probably identical.

† Journ. Cincinnati Soc. Nat. Hist. 1878, t. ii. f. 13.

and terminating around the mouth in blunt processes. Ambulacra lanceolate-petaloid, tapering but little, with a well-marked food-groove, and another groove on each side subparallel to it. Lying on the lancet-plate between the food-groove and these lateral grooves are the side plates, that portion of the ambulacra outside the latter being in all probability firmly anchylosed outer side plates; pinnule-sockets large. Hydrospire-slits seven in number in each interradius, half exposed, and one covered by the edge of the adjacent ambulacrum. Mouth very small; anus rhomboid. Surface smooth in the example under examination, but probably ornamented by striæ following the margins of the plates.

Obs. We are indebted for this interesting species to our friend Dr. G. J. Hinde, who believes it to be identical with *Codaster canadensis*, Billings (MS.). The few remarks* made by Mr. Billings about *C. canadensis* are quite insufficient for its identification; and we have therefore much pleasure in associating our specimen with the name of its discoverer, who has so earnestly worked in the field of Canadian palæontology.

The form of the radial plates, irrespective of other characters, at once distinguishes *C. Hindei* from *C. pyramidatus*, Shumard, and therefore probably also from *C. americanus* of the same author. The diagnosis of *C. Whitei*, Hall, partakes more of a generic than of a specific character; but it also appears to be a distinct species. The length of the radial sinuses and ambulacra, and the angle at which they are inclined to the general plane of the summit, sharply distinguish *C. alternatus*, Lyon, from *C. Hindei*, and give the two species a very different appearance. Further, in the summit of the former, when viewed from above, portions of the inturned upper edges of the radial plates are visible; but in *C. Hindei* the perpendicular position of the sides of these plates quite prevents their appearing on the ventral aspect, where nothing is visible but the true summit-characters.

Loc. and Horizon. Arkona, Ontario, Canada. Hamilton Group, Upper Devonian (Coll. G. J. Hinde, Ph.D., F.G.S.).

Genus Granatocrinus (Troost, 1850, MS.), Meek & Worthen (redef. E. & C. 1882).

Orbitremites, J. E. Gray (MS.), Synop. Brit. Mus. 1840, p. 63.
Granatocrinites, Troost (MS.), Proc. Amer. Assoc. Adv. Science for 1849, p. 62.

* Amer. Journ. Sc. 1869, xlviii. p. 79.

Granatocrinus, (pars) Hall, 15th Annual Rep. State Cab. N. York, 1862, p. 146; (pars) Shumard, Trans. St. Louis Acad. 1865 (?), ii. p. 375; (pars) Meek & Worthen, Illinois Geol. Survey Report, 1866, ii. p. 274.

Obs. The majority of American palæontologists have agreed to distinguish as a separate genus a series of forms having the general structure of *Pentremites Norwoodi*, O. & S., *P. melo*, O. & S., and *P. Sayi*, Shumard. To these have been applied the name *Granatocrinus*, which was first proposed by the late Dr. G. Troost as *Granatocrinites*, the type being the *G. cidariformis*, Troost. Neither of these ever became more than a MS. name; and, according to Dr. Shumard*, the species is identical with *Pentremites granulatus*, Römer. The latter unfortunately is equally little known, having been described only from an internal cast, no mention being made of the summit-characters. Under these circumstances, and for a due appreciation of the generic characters, we are obliged to seek another type. We believe this may be most readily found in *Pentremites Norwoodi*, O. & S., not only from its general acceptance as a typical *Granatocrinus*, but as one of the species first referred to this genus.

We believe that Prof. James Hall was the first to use the name *Granatocrinus* †, although without any precise definition, and after him Dr. Shumard ‡, who included in it a larger number of species than have been retained by later American writers. The first actual description of *Granatocrinus* to appear was by Meek & Worthen §, who supplement their definition by the following remarks:—"The generic formula of this group is exactly the same as that of *Pentremites*, Say, so far as regards the number andar rangement of the pieces forming the body, though the form and proportions of these pieces are so unlike as to give a very different outline and general physiognomy to the entire fossil. They are therefore readily distinguished from Say's genus, as properly restricted, by the irregular oval, elliptical, or subglobose form, concave or less protuberant base, and much narrower and more elongated pseudo-ambulacral areas, which extend the entire length of the body, so as to give it more the appearance of an Echinoid. They likewise present differences in the arrangement of the ovarian (?) openings of the summit, which are more intimately connected with the interradial pieces, being sometimes excavated one into each lateral

* Trans. St. Louis Acad. ii. p. 375.

† 15th Annual Report State Cab. Nat. Hist. New York, 1862, p. 146.

‡ *Op. cit.*

§ Illinois Geol. Survey Report, 1866, ii. p. 274.

margin of these pieces (*G. Sayi*)—or, in other instances, piercing directly through them, so that each pair appears externally as a single opening (*G. melo* and *G. Norwoodi*), though they divide into two distinct canals before passing entirely through the plates. The typical forms of this genus also have the interradial pieces proportionately much larger than in the true *Pentremites*, though this is not a constant character."

On a comparison of the species thus separated from *Pentremites* and united under *Granatocrinus*, we find that they belong to two well-defined morphological groups. To the first of these, having for its type *Pentremites Norwoodi*, O. & S., we propose to restrict the name *Granatocrinus*; and to the other, typified by *Pentremites Sayi*, Shum., we apply the name *Schizoblastus*.

The lancet-plate of an ordinary *Pentremites* does not fill the radial sinus, but only occupies its central portion. Between it and the walls of the sinus therefore a groove is left, at the bottom of which are the slits of the hydrospires. This groove is continued from the peristome on either side of the apical end of each oral piece and down to the end of each ambulacrum. It is not, however, left open, but is converted into the "hydrospire-canal" by the side plates, which are wedged in between the lancet-plate and the walls of the sinus. In the proximal portions of the ambulacra these walls are formed by the oral plates, the central ridge of which is sometimes comparatively prominent, so as to separate the proximal side plates of adjacent ambulacra, but sometimes so reduced that these plates meet their fellows over the top of the oral ridge. In either case, however, the passage from the peristome between the lancet-plate and the calycular plates becomes converted into a canal, which is roofed over by the side plates and opens at the summit by the so-called spiracle. This is the structure of the summit in *Pentremites* proper.

In *Granatocrinus Norwoodi*, and in all the species met with in British rocks, with one exception, the lancet-plate almost entirely fills up the radial sinus, and the narrow hydrospiral canals are continued upwards *through the substance of the oral plates* *, opening externally usually by five, but in one case (*G. Rofii*) by ten, apertures †. Most of the other

* This structure was originally described by Dr. C. A. White in *G. Norwoodi* (Boston Journ. Nat. Hist. 1863, vii. no. 4, p. 483).

† We have a specimen of *G. Norwoodi* in which one of the oral plates is pierced by *two* spiracular openings instead of by one only. This is the natural condition of four of the oral plates of the British *G. Rofii*, the fifth one having a large anal spiracle as in all the species of this genus.

American species referred to *Granatocrinus*, as *G. melo* and *G. Sayi*, have ten *notches* in the sides of the oral plates, instead of pores, and will constitute our genus *Schizoblastus*.

The species forming *Granatocrinus* so emended are the following:—

I. *Typical Species.*

G. Norwoodi, O. & S.	Burlington Limestone (Subcarboniferous), Iowa.		
G. ellipticus, Phill.	Carboniferous	Limestone,	England.
G. derbiensis, Phill.	"	"	"
G. orbicularis, Phill.	"	"	"
G. campanulatus, M'Coy.	"	"	"
* *G. pisiformis*, sp. nov.	"	"	"
G. M'Coyi, sp. nov.	"	"	"

II. *Aberrant and Doubtful Species.*

G. elongatus, Phill.; *G. Rofii*, sp. nov. Both from the Carboniferous Limestone.

The form and general appearance of the calyx presents a remarkable uniformity of type throughout the species which we have restricted under the name of *Granatocrinus*. Two broad divisions may be traced—the first after the type of *G. Norwoodi*, the second after that of *G. ellipticus*. In the first the form is subglobose; and, includes all the British species except the one named. The latter forms a division of itself and is elongately elliptical.

The summit is more or less flattened in all, or even at times a little depressed. The base is usually small, flattened, or concave, the amount of the concavity varying according to species, the basal plates never being visible in a side view: in *G. Norwoodi* it is narrow and deep, in *G. orbicularis* broad and shallow, the same in *G. ellipticus*, rather deeper in *G. derbiensis*, broad and almost flat in *G. campanulatus*, in fact broader in this species than in any other.

The proportions of the radial and oral plates of *Granatocrinus* vary considerably; some species have large radials and small orals, others small radials and large orals. Generic subdivision has before now been attempted according to the relative sizes of these plates; but, as Messrs. Meek and Worthen have very justly observed, speaking of the orals in particular, "there are so many gradations in this character, however, that it does not seem to be possible to make it a means of separating the species into two well-defined sec-

* These will be described in our more extended work on the Blastoidea.

tions"*. In this we entirely concur. *G. Norwoodi* possesses very large radial plates, extending from the edge of the hollow base almost to the very apex of the calyx, and correspondingly small orals. On the other hand, in the British species, although the radials maintain their general superiority of size in all but one species, the orals are larger than in the American type. A gradation, however, is traceable in *G. pisiformis*, in which they are smallest, to *G. orbicularis*, which possesses the largest oral plates with the exception of *G. derbiensis*. In the latter they attain an inordinately large size, the radial plates being only just sufficiently high to enclose within their sinuses the distal ends of the long ambulacra. The spiracles open in all the species, whether the oral plates are large or small, on the mamillary projections at the apices of the latter †; but in *G. pisiformis* they are bounded externally by nodular elevations of the plates. Dr. C. A. White has shown that the anal spiracle in *G. Norwoodi* is bordered on the outer side by a solid projection formed by a part of the oral plate ‡. Meek and Worthen suggested that the anal plate consisted of three pieces §; but we have not met with any evidence confirming this view.

The ambulacra of *Granatocrinus* are always long, curved, and narrow, and reaching to the base—the calyx usually resting, when placed on its base, on the distal ends of the ambulacra. This appears to be an essential character of the genus, and is one of the points in which it agrees with *Schizoblastus*. The side plates in the ambulacrum of *Granatocrinus*, unlike those of *Pentremites*, do not lie against the sides or edges of the lancet-plate, but actually upon it, so as to conceal the greater part of it. The portion left exposed is the crenulated ridge of the lancet-plate, bearing the zigzag ambulacral or food-groove. This is the structure in *G. ellipticus*, *G. campanulatus*, *G. orbicularis*, and *G. derbiensis*, whilst in *G. Norwoodi* it is perhaps more exposed than in any other species we have as yet been able to refer to this genus. The side plates are variable in number according to species (from twenty to eighty), and are usually transversely elongated. The ambulacra are at times deeply impressed within the prominent edges of the radial forks.

A good deal of variation is shown in the formation of the pores. In *G. orbicularis* they are enclosed between the margin

* Illinois Geol. Report, ii. p. 275.

† First pointed out in *G. Norwoodi* by Owen and Shumard (Journ. Acad. Nat. Sciences Philadelphia, 1850, ii. pt. 1, p. 64).

‡ Boston Journ. Nat. Hist. 1863, vii. no. 4, p. 483.

§ Illinois Geol. Surv. Rep. 1873, p. 465.

of the radial, the lower margin of the side plate above, and the upper oblique margin of the outer side plate, and are, roughly speaking, triangular in shape. The result of this is that the pores are excavated wholly in the outer side plates; but in *G. ellipticus* a slightly different arrangement is met with. Here the pores are excavated out of the side plates themselves, the upper edge of the outer side plates being quite straight and not at all cut into. In *G. campanulatus* the pores are scarcely excavated in the ambulacral plates at all, but are almost wholly so in the edges of the radial plates. There also appear to be slight modifications in the arrangement of the sockets placed on the side plates. In *G. orbicularis* they terminate narrow grooves which arise from the lower sutures between the side plates and the outer side plates, running almost straight on to the centre of each side plate. There is a similar structure in *G. elongatus*, a somewhat aberrant form, which will probably have to be referred to the present genus. But in *G. ellipticus* the groove communicating with the socket arises from the suture separating the side plates themselves, and must have been in direct communication with the pore.

We have come to the conclusion that in *Granatocrinus*, as understood by us, there is no under lancet-plate, as there is in *Pentremites* and *Orophocrinus*; and we are glad to find ourselves in accord with Messrs. Wachsmuth and Springer on this point *.

In *Granatocrinus* the hydrospires are few in number. *G. Norwoodi* possesses two on each side of an ambulacrum, whilst *G. campanulatus*, *G. orbicularis*, *G. ellipticus*, and *G. derbiensis* have only one each. The abnormal species *G. elongatus*, to which we shall refer further on, possesses three on each side.

The central aperture and spiracles in the type species *G. Norwoodi*, as originally pointed out by Messrs. Owen and Shumard, are closed by a conical integument of small plates †; but our researches amongst the British species have not rewarded us by the discovery of a similar feature. Through the disinterested kindness, however, of Mr. Charles Wachsmuth we have been afforded the opportunity of examining some fine examples of *G. Norwoodi* in that condition. It has also been pointed out by Dr. C. A. White that in the same species this plated integument passes down and covers the central food-groove of the ambulacra ‡.

* 'Revision,' pt. 2, t. xx. f. 6.

† Journ. Acad. Nat. Sciences Philadelphia, 1850, ii. pt. 1, p. 65; also see Shumard, in Swallow's Missouri Geol. Report, 1855, p. 186.

‡ Boston Journal, *l. c.* p. 484; see also Meek and Worthen, Proc. Acad. Nat. Sciences Philadelphia, 1869, p. 85.

The calyx in *Granatocrinus* is highly ornate. Concentric striæ, often becoming reticulate, or fine granules arranged in lines, cover the plates.

We append a list of doubtful species of "*Pentremites*," which we have been unable to refer either to *Granatocrinus* or to *Schizoblastus*. We have not seen specimens of any but the first mentioned; and though figures have been published of some, they are of as little use as most of the specific diagnoses for the determination of the generic affinities of these doubtful forms:—

Pentremites angularis, Phillips. Carboniferous Limestone, England.
P. curtus, Shumard. Archimedes Limestone (Subcarboniferous), Missouri.
P. Shumardi, M. & W. Burlington group (Subcarboniferous, Iowa.
P. Rœmeri, Shumard. Chemung group (Upper Devonian), Missouri.
?*P. calyce*, Hall. Hamilton group (Upper Devonian), W. New York.
?*P. leda*, Hall. Hamilton group (Upper Devonian), W. New York.
?*P. lycorias*, Hall. Hamilton group (Upper Devonian), W. New York.
?*P. maia*, Hall. Hamilton group (Upper Devonian); Moscow, New York.
P. cornutus, M. & W. St.-Louis group (Subcarboniferous), Illinois.
P. granulatus, Roemer.
P. lotoblastus, White. Subcarboniferous, Arizona.

We possess in our English Carboniferous Limestone a species, *Pentremites elongatus*, Phillips, which is to all intents and purposes a *Granatocrinus*, so far as general appearance goes. The ambulacra, however, are relatively wider than in a typical *Granatocrinus*; and the spiracles are formed more after the type of *Pentremites* proper. The contracted apex and base, with concavity of the latter, the long curved ambulacra, long radials, and small orals, correspond nevertheless so closely with those of the former genus that we feel somewhat undecided at present whether to place it there or frame a separate genus for its reception.

In its emended form *Granatocrinus* is strictly confined to rocks of Carboniferous age—one species being found in the United States of North America, and six in England. On the

other hand, the number of American species may at any moment be augmented by one or more of the doubtful ones. Further, if certain forms described by Prof. James Hall are subsequently found to be referable to this type, the genus will have commenced its existence in the Upper Devonian of North America.

Genus Schizoblastus, gen. nov.

Gen. char. Calyx resembling that of *Granatocrinus* in form and composition of the ambulacra. Oral plates of variable size, but usually small. Spiracles double, being linear or oval clefts between the lancet-plate and notched edges of the orals, further removed from the peristome than in *Pentremites*, and not floored by the oral plates (as in the latter genus); those in the anal interradius may or may not be confluent with the anal aperture.

Obs. That some restriction of the then existing genus *Granatocrinus* was felt to be necessary by American palæontologists may be gathered from the following remarks by Messrs. Meek and Worthen, who, speaking of *Pentremites melo* and *P. projectus*, say, "Both of these forms differ from the typical species of *Pentremites*, in having each pair of ovarian openings distinctly separate, instead of closely united, with merely a thin septum between . . . . They constitute a subgenus of *Pentremites*"*. The form of the calyx in *Schizoblastus* is, as a rule, pentagonal subglobose, or melon-shaped, and when viewed in section is either simply pentagonal, as in *S. Sayi*, or imperfectly decagonal, as in *S. melo*, *S. melonoides*, or *S. missouriensis*. The summit and base are much contracted when compared with the apices of other genera. The former is, generally speaking, to some extent flattened, whilst the latter varies between very concave, truncate, or slightly protuberant. In *S. melo*, *S. Sayi*. *S. melonoides*, and *S. missouriensis* the concavity is but slight, in some individuals so much so as to appear almost flat, whilst in *S. glaber* it is broad and apparently truncate. On the other hand, in *S. granulosus* the base is deeply concave, the radial plates being quite hidden in the depression, so that they are invisible in a side view. A similar concavity also exists in *S. pisum*. Lastly, in *S. neglectus* and *S. projectus* the base projects to a greater or less degree, and is visible when the calyx is placed in an erect position before the observer.

The radial plates resemble those of *Granatocrinus* by their extreme variability in size. In *S. melo*, *S. melonoides*, and

* Proc. Acad. Nat. Sciences Philadalphia, 1861, p. 142.

S. projectus they are very large, extending through all but the whole length of the calyx. Those of *S. Sayi*, on the contrary, are exceedingly short, extending upwards only sufficiently far to enclose the distal ends of the long ambulacra in their forks or sinuses. In *S. glaber* and *S. missouriensis* the radials are again short, but not quite to the same extent as in *S. Sayi*, whilst in the former they are much incurved below, to assist in forming the truncate base. The radial sutures are placed in concavities or re-entering angles of the calyx in *S. melo*, and, to a certain extent, in *S. missouriensis*, giving to the entire body a markedly lobate appearance, and to the cross sections a roughly decagonal outline. The oral plates of this genus have no depressed apical tongues more or less divided by a median ridge into two lateral halves, each of which forms the floor of a spiracle, as is the case in *Pentremites*. The size of the orals is naturally in inverse proportion to that of the radial plates. For instance, they are very small in *S. melo*, *S. melonoides*, and *S. projectus*, and confined quite to the summit. They are comparatively small again in *S. pisum*, but of medium size in *S. glaber* and *S. granulosus*, and more than one third the length of the body in *S. neglectus*. In *S. Sayi*, on the contrary, the orals reach their extreme limit of size, to compensate for the diminished radial plates. This species occupies the same position in *Schizoblastus* that *G. derbiensis* does in *Granatocrinus*, the relation of the two sets of plates in question affording a very marked point of resemblance between the two genera.

The spiracles are oval or linear slits, one on either side of each ambulacrum, but situated at a relatively greater distance from the centre than those of *Pentremites*. The hydrospire-cleft between the edge of the lancet-plate and the side of the radial sinus is roofed over and converted into a canal by the side plates, the outer faces of which rest against the straight edges of the orals at the proximal ends of the ambulacra. These straight edges, however, are not continued right up to the peristome. Some little distance before reaching it they bend inwards towards one another, and then curve outwards again before converging towards one another at the apex of the plate. At these points, therefore, the hydrospire-clefts are slightly wider than at the more distal parts of the ambulacra; and as the latter decrease in width the side plates fail to fill up the gap between the lancet-plate and the orals, which is thus left open as a spiracle, and is not closed by the summit-plates when these are present. The spiracles of *Schizoblastus*, speaking generally, are much more outside the orals than those of *Pentremites*. It is well shown in *S. Sayi*,

where the anus perforates one of the oral plates, while the spiracles are partly formed by notches in its side*. The spiracles vary but little in size, and, as a rule, are very small, as in *S. pisum*, *S. neglectus*, *S. melo*, &c., but of larger size in *S. glaber*. The anal spiracle is always very disproportionate in size as compared with the others. It is frequently bounded on its outer margin by a tubercle or boss of greater or less elevation, as in *S. neglectus*, *S. granulosus*, and *S. melo*. The anal opening is said to be circular in *S. pisum*, ovate in *S. Sayi*, and pyriform in *S. melo*. The summit of *S. melo* presents some departures from the type described above, which approximate it to *Pentremites* proper. This is especially marked in specimens which have the side plates *in situ* at the central ends of the ambulacra. A wide median ridge rising from the apex of each oral plate separates two spiracular openings, which are apparently constructed upon the same type as those of *Pentremites*, viz. floored by oral plates and leading into a hydrospiral canal, roofed in by side plates.

The real state of the case, however, is as follows:—The lancet-plate is separated from the radial plates by the thick upper edge of the inner wall of the hydrospire-tubes. Minute cross pieces between this plate and the sides of the radials convert the hydrospire-cleft into a canal opening externally by pores between these cross pieces, whilst the side plates, resting on the latter, alternate with the pores as usual. But this hydrospire-plate terminates at the oro-radial suture; and at the central end of the ambulacra the lancet-plate comes into direct and continuous contact with the orals without leaving any intervening pores, although the side plates rest on it as usual. Between the converging edges of the lancet-plate and the large notches in those of the oral plate at its sides are the spiracular openings, which lead downwards beneath the lancet-plate into the hydrospiral canal, and are not floored by the oral plates, as are those of *Pentremites*. But the anal spiracle

* The peculiar manner in which the spiracles of *Schizoblastus* are formed is excellently shown in Wachsmuth and Springer's figure of *S. Sayi* (Revision, ii.). But we cannot at all acquiesce in their interpretation of the calycular plates of this type. It is generally supposed to have large orals which form the greater part of the calyx. The above-named authors, however, limit their name to small rhomboid pieces immediately round the summit, which we take to be merely the apical ends of large oral plates. Further, they represent a suture as occurring below these tongues and the great plates outside them, which they indicate as the fork-piece (radials). We cannot, however, make out either this suture or the interradial one represented by them as between the two limbs of adjacent radials; for the latter occupies the middle line of what we, like earlier writers, take to be large deltoid or oral plates.

is so large as to remove all trace of the broad median ridge separating the two spiracles at the sides of the corresponding oral plates; and the lateral tubes are therefore fused with the anus into one large anal spiracle—a character which increases the resemblance between the summit-structure of this species and that of *Pentremites* proper. Except in *S. melo*, the spiracles of *Schizoblastus* are at the sides of the proximal side plates, whilst those of *Pentremites* are between the latter and the mouth.

We have not succeeded in ascertaining whether or not the lancet-plate is double, as in *Pentremites*; but we believe that it is not. In *S. Sayi* it is undoubtedly traversed by three canals, one being that of the water-vessel. The nature of the other two is not at present clear to us; but we hope to discuss the question fully in our larger work. The side plates in *Schizoblastus* rest on the lancet-plate, partially hiding it from view, and not simply against it as in *Pentremites*.

It is scarcely visible in *S. melonoides*, *S. pisum*, and *S. neglectus*, rather more exposed in *S. melo*, and still more so in *S. Sayi*, in which it occupies the median third of the ambulacrum. The side plates vary from about twenty to eighty in number on each side of the ambulacrum. They number about twenty-six in *S. pisum*, from twenty-five to thirty in *S. neglectus*, *S. glaber*, and *S. granulosus*, and eighty in *S. Sayi*. Outer side plates are unknown in *S. melonoides*, *S. pisum*, *S. neglectus*, and *S. glaber*.

We are acquainted with the number of hydrospires in only *S. Sayi*, in which there are four on each side.

Not unfrequently a sulcus of variable depth occurs on each side the ambulacra, between the ends of the side plates and the edges of the radial sinuses. The ambulacra are either on the same level with the general surface of the calyx, as in *S. Sayi* and *S. projectus*, or a little below it, as in *S. granulosus*.

The surface of the plates in *Schizoblastus* is usually highly ornate; but *S. glaber* is described as smooth. The species definitely included in this genus are:—

Pentremites melo, Owen and Shumard. Subcarboniferous, Iowa, Missouri, Illinois, &c.
P. Sayi, Shumard. Ditto.
Granatocrinus melonoides, Meek & Worthen. Burlington group (Subcarboniferous), Iowa.
G. pisum, Meek & Worthen. Burlington group, Iowa.
G. neglectus, Meek & Worthen. Ditto.
G. glaber, Meek & Worthen. St.-Louis group, Illinois.

Granatocrinus granulosus, Meek & Worthen. Keokuk group (Subcarboniferous), Illinois.
Pentremites missouriensis, Shumard. Chemung (Devonian), Missouri.
Granatocrinus projectus, Meek & Worthen. Burlington group (Subcarboniferous), Iowa.
Pentremites Potteri, Hambach. Ditto.

With the exception of one species, *S. missouriensis*, which is found in the Chemung group (a division of the North-American Devonian), the whole of the species are of Carboniferous age, and confined to America.

Genus Troostocrinus, Shumard, 1865.

Troostocrinus, Shumard, Trans. St. Louis Acad. 1865, ii. p. 384 (note); Meek & Worthen, Illinois Geol. Report, 1873, v. p. 507.

Obs. This genus was proposed by Dr. Shumard, in his useful Catalogue of North-American Palæozoic fossils, for subfusiform species of *Pentremites*, after the type of *P. Reinwardtii*, Say, possessing a slender outline, triangular base, and linear ambulacra. The genus was never described in detail, but was adopted by Messrs. Meek and Worthen provisionally. To it they ascribe species with a triangular base, flattened on all three sides, a narrow fusiform body, elongate and tapering below, and narrow ambulacra.

Dr. Shumard's remarks are as follows:—"There appear to me good reasons for removing this and other subfusiform species, as *Pentremites Reinwardtii*, *P. lineatus*, *P. bipyramidalis*, *P. Wortheni*, and perhaps *P. Grosvenori*, from among the *Pentremites*, and grouping them together in a separate subsection under another name. These and allied forms are remarkable for their slender subfusiform shape, linear pseudambulacral fields, triangular base, and simple summit-structure. These external differences would seem to imply corresponding modifications in the internal economy of the animals of more than specific importance. If, from a more thorough study of such species, it should be deemed advisable to separate them from the genus *Pentremites*, I would propose the name *Troostocrinus* for the group," &c.*

In this proposal we entirely concur; but as our acquaintance with the genus depends simply on the structure of *T. Reinwardtii* and *T. lineatus*, we shall confine our descriptive remarks to these species. The most important morphological difference between *Troostocrinus* and *Pentremites* lies in the

* *Loc. cit.*

structure of the spiracles. Those of *Troostocrinus* are at the sides of the proximal side plates, as in *Schizoblastus*, while those of *Pentremites* are between the proximal side plates and the mouth. The spiracles, more especially those of *T. lineatus*, are intermediate in structure between those of *Pentremites* and the American species of *Orophocrinus*. The distal portions of the ambulacra resemble those of a *Granatocrinus*, the lancet-plate and its superposed side plates almost completely filling up the radial sinus, so that the hydrospiral pores are small and inconspicuous. Towards the summit, however, the width of the deep radial sinuses increases considerably, while that of the ambulacra decreases a little, and the side plates do not meet the orals. The hydrospiral canals therefore open out into linear spiracular apertures, those of the anal side being nearer the centre than, and quite distinct from, the anus. If the distal portion of the lancet-plate were in continuous instead of interrupted contact with the sides of its radial sinus, *T. lineatus* would have the same form of respiratory openings as *Orophocrinus gracilis*, M. & W. sp., a slit extending for a short distance along each side of the ambulacra.

On the other hand, if the summit were rounder, the radial sinus shallower, and the spiracles shorter and wider, *Troostocrinus* would be essentially a Pentremite with narrower ambulacra than usual. Therein lies the difference between the two types, and also between *Troostocrinus* and *Pentremitidea*. We believe that this form of spiracle, coupled with the characters indicated by Dr. Troost, will prove to be of generic value; and we propose to adopt *Troostocrinus* accordingly.

The peristome is more contracted in *T. Reinwardtii* and *T. lineatus* than in almost any other Blastoids. The oral plates are very minute, entirely confined to the summit, as well as inconspicuous, like those of *Pentremitidea* and *Phænoschisma*. The ambulacra are deeply set in the radial sinuses, but deeper in *T. lineatus* than in the other species. The side plates are few in number in *T. Reinwardtii*, but much more numerous in *T. lineatus*. The lancet-plate is almost entirely concealed by the side plates, as in some species of *Granatocrinus* and *Schizoblastus*. In *T. lineatus* it contains three canals arranged in a triangle, similar to those of *Schizoblastus*. The hydrospires, in the only two forms in which we have seen them, are three or four in number on each side; *T. Reinwardtii* possesses three, and *T. lineatus* four.

The following is a full list of the species which will probably be comprised in *Troostocrinus* *:—

* We are acquainted by examination with the two type species only,

Pentremites bipyramidalis, Hall. Keokuk limestone (Subcarboniferous), Missouri.
P. clavatus, Hambach*. Subcarboniferous, Illinois.
P. Grosvenori, Shumard. Archimedes limestone (Subcarboniferous), Indiana.
P. lineatus, Shumard. Encrinital limestone (Subcarboniferous), Illinois.
P. Reinwardtii, Troost. L. Helderberg group (Upper Silurian), Kentucky.
P. subcylindrica, Hall. Niagara group (Upper Silurian), Ohio.
P. subtruncatus, Hall. Hamilton group (Up. Devonian), Iowa.
P. Wortheni, Hall. Keokuk limestone (Subcarboniferous), Iowa &c.

If all the above species are rightly placed under *Troostocrinus*, the genus then made its first appearance in the Upper Silurian, reappeared in the Upper Devonian, and culminated in the Carboniferous. We are not acquainted with any *Troostocrinus* from the Palæozoic rocks of this country or of the continent; so that it appears to be entirely an American genus.

Genus Orophocrinus, Von Seebach, 1864.

Orophocrinus, von Seebach, Nachr. k. Gesellsch. zu Göttingen, 1864, p. 110.
Codonites, Meek and Worthen, Proc. Acad. Nat. Sci. Philadelphia, 1869, p. 84 (note); Meek and Worthen, Illinois Geol. Survey Report, 1873, v. p. 463.

Obs. Von Seebach was the first to point out the distinction of this generic type from that of the ordinary *Pentremites*; and although it received the name *Codonites* five years later, we feel bound to follow Ludwig and Zittel in using Von Seebach's name rather than that of the American authors. Both chose for their type the *Pentremites stelliformis*, Owen and Shumard.

The second description by Meek and Worthen is sufficiently explicit to make it unnecessary for us to redescribe the genus; we need only at present point out a few of its peculiarities, more especially in connexion with the European species.

But two species of *Orophocrinus* are at present known, both of them from the American Carboniferous series, viz.

T. Reinwardti and *T. lineatus*; but the other species agree so well in form and outline with these, that we can hardly doubt their generic identity.

* Non *P. clavatus*, Schultze, Devonian, Eifel.

O. stelliformis, O. & S., sp., and *O. gracilis*, M. & W. In European rocks of corresponding age five species are now known to occur. There are two British Blastoids referable to this type, viz. *Pentremites inflatus*, Phillips, and *P. pentangularis*, Miller, sp., whilst the other three are met with in the Carboniferous Limestone of Belgium—*Pentremites Puzos*, Münster, *P. Orbignyanus*, de Koninck, and *P. Waterhousianus*, de Kon. The first two of these are somewhat aberrant forms, presenting considerable differences from the American species, which approximate them to *Phænoschisma* and *Codaster*.

The gap, however, is bridged over so completely by *O. inflatus*, Phillips, sp., and *O. Waterhousianus*, de Kon., sp., that we have no choice but to refer them to this genus.

Orophocrinus differs from *Pentremites* proper, *Granatocrinus*, *Schizoblastus*, *Pentremitidea*, and probably also from *Troostocrinus* and *Tricœlocrinus*, in the absence of marginal pores to the ambulacra and of circumoral spiracles. The place of these organs is taken by the ten elongated slits which run parallel or subparallel to the ambulacra. Further, the anal aperture of *Orophocrinus* is separate and distinct from these hydrospiral openings, having no connexion whatever with the latter, as is the case with the fifth or complex spiracle of the genera mentioned above. Lastly, the orals, in consequence of the absence of distinct spiracles, are imperforate. *Orophocrinus* thus possesses only one series of openings leading to the hydrospires, viz. the ten elongated slits bordering the ambulacra. The apparent difference in number between the latter and the five spiracles of a Pentremite is lessened when we recollect that in the last-named genus the spiracles are divided internally by a septum, whilst in *Schizoblastus* they are separately developed and correspond in number to the hydrospire-clefts of *Orophocrinus*.

In the widening of these clefts in the Belgian species, *O. puzos*, Münster, sp., and *O. Orbignyanus*, de Kon., sp., and the partial exposure of the hydrospire-slits, we see a foreshadowing of the conditions met with in *Phænoschisma* and *Codaster*. In both these genera there is likewise a separate anal aperture, whilst the anal interradius bears hydrospire-clefts in *Phænoschisma* and *Orophocrinus*, but not in *Codaster*.

A tendency towards the form of the true Pentremite is exhibited by one species in particular, the *O. gracilis*, M. & W.*, more than in any of the others. Although possessing the characteristic features of *Orophocrinus*, the upper portion of the calyx is much higher and less depressed than in the typical *O. stelliformis*. It also bridges over the gap between the American and European species; for not only are the hydro-

* *Loc. cit.* v. t. 8. f. 6.

spire-clefts in the latter much wider than in the former, but they are also contiguous to the ambulacra, without the intervention of a part of the radial plate.

D'Orbigny's *Dimorphicrinus** is undoubtedly congeneric with *Orophocrinus*. In the original definition it is said to have only two rows of plates; but de Koninck has since shown † that it was founded on *Platycrinites pentangularis*, Miller, which he considered a Pentremite deprived of its oral plates, whilst we hope to definitely show its relation to *Orophocrinus*.

We agree with the late Mr. Billings in regarding the structure of *Orophocrinus* as of more than generic importance when compared with that of other Blastoids; and we follow Meek and Worthen, as does Zittel, in regarding *Orophocrinus* as a Blastoid and not a Cystidean, as it was asserted to be by Billings ‡. He seems to have been led to this conclusion by the discovery of specimens with the peristome closed by minute plates, and by his peculiar views as to the mouth being confluent with the anal aperture. The absence of hydrospire-pores and spiracles we believe to be points of the greatest structural importance within the Blastoidea, but not sufficient in themselves to eliminate *Orophocrinus* from that class.

The oral plates, except in well-weathered specimens, are difficult to see, but are usually acutely arrowhead-shaped (*O. Waterhousianus*, *O. gracilis*, and *O. Orbignyanus*), or double diamond-shaped, with a constricted middle, as in *O. stelliformis*. The anal aperture is large, and either oval, as in the last-named species, or elongately and roundly triangular. In *O. stelliformis* it also has an outer raised margin; but we have not observed any tube or small proboscis as described in this form by Messrs. Wachsmuth and Springer §.

The ambulacra are linear in all but *O. Orbignyanus*, where they broaden out, and they possess only one groove, the food-groove, not three as in *Codaster*. We have not succeeded in detecting any sign of outer side plates, unless it be in *O. Orbignyanus*; but of this we cannot be sure. Meek and Worthen say they are unknown in *O. stelliformis*; but they appear to figure them in *O. gracilis*‖. The length of the hydrospire-clefts is a variable character. They are shortest in *O. stelliformis*, but extend nearly the whole length of the ambulacra in *O. Waterhousianus* and *O. pentangularis*, and quite that in *O. inflatus* and *O. Orbignyanus*. As before stated, no true spiracles are present; but the clefts enlarge upwards towards

* Prodrome de Pal. 1849, i. p. 155.

† Rech. Crinoïdes Terr. Carb. Belgique, p. 194.

‡ American Journ. Sc. 1870, i. p. 234.

§ Revision, pt. 2.

‖ Illinois Geol. Surv. Report, 1873, v. t. 8. f. 6.

the peristome and form a kind of spurious spiracle; this is particularly noticeable in *O. stelliformis.* The lancet-plate appears to be exposed in all the species in its upper part; but towards the distal extremity the side plates meet in the middle line and close over it, the amount of covered surface varying according to species.

The side plates are very numerous in *O. inflatus* and *O. pentangularis*; but the state of preservation of our specimens does not permit of the actual number being ascertained. *O. stelliformis* is said to possess fifty; and twenty-two exist in *O. gracilis.* There are at least twenty-five in *O. Waterhousianus*, and something under twenty in *O. Orbignyanus.* The hydrospires, so far as we are acquainted with them, vary from four to eight. There are five in *O. stelliformis*, from seven to eight in *O. inflatus* and *O. pentangularis*, and at least four in the two Belgian species.

We have not observed in either of the European species a plated peristome as described by Dr. C. A. White*; but we entertain little doubt that it existed in the perfect form.

The following are the species we refer to *Orophocrinus*:—

Codonites gracilis, M. & W. Burlington group (Subcarboniferous), Iowa.

Pentremites inflatus, Gilb. Carboniferous Limestone, England.

P. Orbignyanus, de Kon. Carboniferous Limestone; Belgium.

Platycrinus pentangularis, Miller. Carboniferous Limestone, England.

Pentremites puzos, Münster. Carboniferous Limestone, Belgium.

Codonites stelliformis, O. & S., sp. Burlington group (Subcarboniferous), Iowa &c.

Pentremites Waterhousianus, de Kon. Carboniferous Limestone, Belgium.

From the above list it will be seen that *Orophocrinus* is entirely confined to rocks of the Carboniferous period, occurring, however, in those of Britain, Belgium, and America. It thus has a wider geographical distribution than any of the other genera occurring in Britain, *Granatocrinus* being as yet unknown on the continent, while the *Pentremitidea* of Spain, the Eifel, and the American Devonian rocks does not occur in Britain; and *Phænoschisma* of England, Belgium, and Spain is but very doubtfully recognizable among the American Blastoids.

* Boston Journ. Nat. Hist. 1863, vii. p. 486.

XXVI.—*Further Observations on Kammplatten, and Note on* Ctenoptychius pectinatus, *Ag.* By Thomas Stock, Natural-History Department, Museum of Science and Art, Edinburgh*.

[Plate VIII. figs. 1–4 *a*.]

Mr. T. P. Barkas, F.G.S., has, with great kindness, allowed me to examine the entire series of Kammplatten contained in his cabinet. Three of them are of interest, and deserve careful description.

No. 6† (Plate VIII. fig. 1, nat. size, and fig. 1 *a*, twice nat. size). Length 11 lines; originally it was somewhat longer. Lamella 4 lines, greatest breadth 2 lines; convex on the upper surface, concave on the lower. The pectination is very fine. Along the middle line there is a series of about eighteen minute punctures. The handle is noticeable for its great relative length; along two thirds of its course it is directed towards the pectinated edge of the lamella; it then bends away from it at a very obtuse angle till it is cut off by the edge of the slab. Its exposed margin is fringed by a very narrow and slightly raised border (see Pl. VIII. fig. 1 *a*), which, when examined by the lens, is seen to be broken up into a series of coarse denticulations, which pass at intervals into more or less prolonged ridges. There are dubious traces of a border on the opposite margin, seen in the matrix where the extremity has been broken away.

Horizon. Low-Main seam, Coal-measures, Northumberland.

Locality. Newsham.

Collection of Mr. T. P. Barkas, F.G.S.

No. 7 (Pl. VIII. fig. 2, nat. size, and fig. 2 *a*, twice nat. size). Length 4 lines; greatest diameter of the lamella 1 line. The lamella is pectinated along the lower two thirds of its margin; the denticles are about seventeen in number; they are the marginal prolongations of striæ, whose origin can be traced back to an indistinct ridge which is continuous with that of the handle to be described. The striæ and their denticular terminations all take a parallel but distinctly oblique direction. The handle (see Pl. VIII. fig. 2 *a*) is short ($1\frac{1}{2}$ line),

* The first part of this communication was read before the Edinburgh Geological Society, Jan. 19, 1882.

† The numbers are continuous with those of the preceding paper on the same subject, 'Annals,' Aug. 1881, p. 95.

broad, and divided longitudinally into two areas; the one is formed by a depression, which follows the curve of the handle to its junction with the pectinated margin of the lamella, the other by an elevated ridge, which occupies the remainder of the surface.

Same horizon, locality, and collection as the last.

No. 8 (Pl. VIII. fig. 3, nat. size, and fig. 3 *a*, twice nat. size). Length 5 lines; greatest width of the lamella $1\frac{1}{2}$ line. The lamella and handle form distinct areas, as in all the specimens so far observed. The lamella is feebly denticulated on one margin. The denticles are about eleven in number, more horizontally directed than in No. 7, and appear to be the slightly prolonged terminations of striæ, whose course cannot be observed very far back. The lamella, like those of No. 6 and No. 2 of the preceding paper*, and in the same relative position, is marked by a series of about fifteen punctures. The handle (see Pl. VIII. fig. 3 *a*) is short (2 lines), broad, and thick. It rises gradually from the plane of the lamella, and terminates abruptly in an elevated polished boss; close to but beneath it there is a rather deep depression; and also close to it, but rather to the underside of it, a much shallower depression can be detected by the aid of the lens. On the handle, near where it enters the lamella, there are a few coarse striæ, which terminate about halfway across towards the non-pectinated aspect of the specimen in slightly elevated denticular prominences. Obscurer indications of these striæ and their denticular terminations can be observed along nearly the whole of the length of the handle.

Same horizon, locality, and collection as the preceding.

A further examination of the black-band ironstone of Burgh Lee, near Edinburgh, has resulted in the discovery of several specimens, referable for the most part to the form described as No. 5 in the preceding paper. One of them, however, is of sufficient interest to be worthy of separate description.

No. 9 (Pl. VIII. fig. 4, nat. size, and fig. 4 *a*, twice nat. size). Length 5 lines; greatest width of the lamella $1\frac{1}{2}$ line. The lamella is damaged along the denticulated (?) margin, so that it is impossible to say what was its original shape. The handle is 3 lines long, much broader than that of the rest of my specimens from the same locality, long in proportion to the entire length of the plate, and tapering to a rounded extremity. A prominent elevation occupies the centre of the handle, is broadest where it enters the lamella, and gradually tapers to a fine point in the opposite direction.

* *Op. jam cit.* p. 94, pl. vi. fig. 2.

Horizon. Carboniferous Limestone series.
Locality. Burgh Lee, near Edinburgh.
In my own collection.

It was known from the specimens described by Prof. Fritsch that the Bohemian Kammplatten were concave on one surface and convex on the opposite, corresponding with similar concavities and convexities on the next apposed plates of the series. The British specimens are constructed on the same plan. Some of them, however, give evidence of the existence of special provisions by which the plates were more closely united with each other. These articulatory specializations are not very strongly developed in all of the specimens; yet they amount in some to a considerable degree of complexity of type. On several of them (Nos. 2, 6, 7, and 8) there are minute punctures or short transverse scratches occurring with uniformity of position along the exposed surfaces of the lamellæ. These possibly fitted into corresponding prominences on the concave areas of the lamellæ of the succeeding plates, though I have not been able to verify this by observation, as nearly all the plates that I have seen have been presented with their convex sides upon the slabs. On the handle, however, of the plate described as No. 8 in this communication (Pl. VIII. fig. 3 *a*) there are striæ terminating at about the centre in denticular prominences, which probably fitted into shallow excavations on the concave area of the handle next in the series. Again, in the same specimen, the two pits near the end of the handle and the boss-like termination of the handle itself probably fitted into elevations and a depression on corresponding parts of the next plate. In this specimen, therefore, there is a high degree of articulatory specialization. In No. 7 (Pl. VIII. fig. 2 *a*) it is of a more simple character, but very distinct; for the rather deep groove and elevated ridge on the handle must have fitted into a similar ridge and groove on the next plate. Again, in No. 9 (Pl. VIII. fig. 4 *a*), there is a well-developed elevation upon the handle, which, there is no reason to doubt, fell into a corresponding hollow on the plate next in succession. In No. 6 (Pl. VIII. fig. 1 *a*) there is the interesting peculiarity of a raised border, developed along one margin certainly, and possibly along the other, of the handle, which may be interpreted as an articulatory provision. Its function, however, is not perfectly clear.

Thanks to this series of detached plates, we obtain a little additional light as to the structure of the apparatus of which they were the parts. That this is not entirely sufficient to remove the doubt surrounding their affinities is tolerably clear;

nevertheless it appears to me that the view of the labyrinthodont origin of these bodies is more conformable with the facts of their structure (as I have endeavoured to describe and interpret them) than with any other "theory" that can at present be offered. Whatever may be their ultimate fate, the reference to *Ctenoptychius* may safely be disregarded. Prof. Fritsch has certainly contributed an interesting puzzle to science, the solution of which will no doubt be found as the rocks are made to yield up their fossil contents.

I regret that my specimens from Loanhead are not well suited for microscopical preparation.

Mr. John Ward, F.G.S., tells me that Kammplatten are found in the Staffordshire coal-field.

Mr. T. P. Barkas corrects* *Ctenoptychius marginalis*, Barkas, to *C. marginalis*, Ag. There appears to be a little doubt as to the authorship of this species, if species it is. It seems to have been first recorded in Portlock's Geol. Report on Londonderry &c., once at p. 461, from a list of fossils supplied by Capt. Jones, M.P., and again at p. 769; but, curiously enough, the authority is not appended in either case. It is omitted too from an interesting account of the genus recently published† by Mr. J. W. Davis, F.G.S.

Note on Ctenoptychius pectinatus, *Ag.*

[Plate VIII. figs. 5–17.]

THE fossils known as *Ctenoptychius pectinatus*, Ag., are pretty generally distributed throughout the Carboniferous Limestone and Calciferous Sandstone series of Midlothian. Specimens have been collected by the Scottish Geological Survey at Juniper Green, and from beneath St. Anthony's Chapel, in the Queen's Park, Edinburgh. They appear to occur sparingly (at any rate, few specimens have been collected) below the limestone of Burdiehouse, from which the type specimens came; but above that horizon they increase in frequency, reaching their greatest abundance in the strata worked for coal and ironstone along the line of country between the Venturefair colliery at Gilmerton and the pits at Glencorse. From these workings, and especially from Gilmerton and Loanhead, I have obtained, partly through the intervention of my friend Mr. W. T. Kinnear, a large number of specimens, which I could easily have increased if it had been worth while. An examination of this abundant material shows that, as Messrs. Hancock and Atthey long since

* '*Ctenoptychius* or Kammplatten,' 'Annals,' Nov. 1881, p. 350.
† 'Annals,' Dec. 1881, p. 424.

pointed out*, every gradation exists between the broad forms, which Agassiz called *C. denticulatus*, and the short, named by him *C. pectinatus*. I have endeavoured to represent (Pl. VIII. figs. 5–17)† a series which connects the two extremes. A consideration of the figures will show that there is a considerable range of variation, not only in the width of the specimens, but in the extent to which the roots are developed and the denticles pointed and fasciculated.

In the forms represented by figs. 6, 12, and 17, the denticles are blunt. In the specimen shown in fig. 12 and in one of those seen on the slab, fig. 17, the concave surface is represented; but in these cases the concavity is slight and the denticles are very little separated at their apices. The blunt appearance is not due to abrasion. The whole of the specimens in fig. 17 are bluntly denticulated, and presumably belonged to the same individual, the only instance of the kind that has as yet occurred to me. It seems more reasonable to believe that all of these obtuse forms are indicative of individual variation rather than of specific difference. The greatest amount of fasciculation may be observed on the fine example shown at fig. 16, the denticles of which tend to arrange themselves in groups of twos and threes. The specimen is somewhat fractured; and I have slightly restored the fang-like processes. In fig. 13 there is very little, if any, fasciculation. In fig. 15, an imperfect specimen, the free area is low and very straight. Figs. 10 and 14 represent examples of the ordinary type, but viewed on their concave aspects. Fig. 10 has an abnormally prolonged base. Most of the specimens give evidence of the production of the covered area into fang-like extensions.

Messrs. Hancock and Atthey suggested‡ that these plates might be dermal appendages. The more generally received view appears to be that they are, as Agassiz thought, Selachian teeth. The unusual prolongation of the base into roots or fangs is nevertheless paralleled in e. g. *Polyrhizodus*, a Selachian tooth; and the histological characters do not point decisively either way.

* "Notes on the Remains of some Reptiles and Fishes from the Shales of the Northumberland Coal-field," Nat. H. Trans. Northumberland and Durham, vol. iii. part i. p. 115 (1869).

† The figures are all of the natural size, and are drawn from specimens obtained at Loanhead in the Carboniferous-Limestone series.

‡ *Loc. cit.*

XXVII.—*On some new Species of* Araneidea, *with Characters of a new Genus.* By the Rev. O. P. Cambridge, M.A., C.M.Z.S., &c.

[Plate XIII.]

The spiders described here are all European, having been sent to me nearly two years ago by Dr. Ludwig Koch, by whom they were found near Nuremberg.

It must be a matter of profound regret to all arachnologists that this able author should be incapacitated (I fear permanently) for further arachnological studies by a malady which has seriously affected his sight.

Family **Theridiidæ.**

Auletta, gen. nov.

This genus is closely allied to *Neriene*, Bl.; but the spider on which it is founded can hardly be contained in any of the genera into which the large assemblage of spiders now included in *Neriene* must inevitably be some day subdivided.

Cephalothorax oblong-oval, much longer than broad, very deeply excavated or indented at its posterior extremity; the lateral marginal constrictions of the caput are gradual.

Eyes as in *Neriene.*

Legs subequal, moderate in length and strength, apparently 4, 1, 2, 3, or 1, 4, 2, 3, furnished with hairs and very slender bristles only, each tarsus terminating with three claws.

Falces rather long, strong, and projecting forwards, armed with a few sharp teeth on their inner sides near the extremity; fang short and weak.

Maxillæ tolerably long, subparallel, nearly straight, very slightly and obliquely truncated at their extremity on the outer side.

Labium somewhat oblong, and half the length of the maxillæ.

Sternum large, of a somewhat oblong heart-shape, nearly as broad as long.

Auletta excavata, sp. n. (Pl. XIII. fig. 1.)

Adult female, length $\frac{1}{13}$ of an inch.

The whole of the fore part of this spider is of a yellow-brown colour, slightly tinged with reddish.

The *cephalothorax* is margined by a slender black line, and has a remarkable appearance, owing to the extensive excavation of its posterior extremity; in other respects its form is

ordinary enough, the profile line of the upper side forming a tolerably regular convex curve. The height of the clypeus is less than half that of the facial space.

The *eyes* are of fair size and rather closely grouped together. Those of the hind central pair are the largest, and are separated by less than a diameter's interval, each being still closer to the hind lateral eye on its side. The four posterior eyes form a straight line. The fore central pair, together with those of the two lateral pairs, forming a strong and even curved line, whose convexity is directed forwards. Those of the fore central pair are nearly contiguous both to each other and to the fore laterals.

The *abdomen* is of a rather short-oval shape, very convex above, and fits into the posterior thoracic excavation; it is of a dark brownish-black hue, clothed with rather longer than ordinary slender hairs.

The spinners are short, compact, and of a yellow-brown colour. The genital aperture (owing to some shrinking of the adjacent parts) was not easy to make out satisfactorily; the figure given, however, is, I think, tolerably correct.

This spider, whose remarkably excavated thorax has chiefly induced me to found a new genus upon it, was kindly sent to me from Nuremberg by Dr. L. Koch, by whom it was found in that neighbourhood.

Genus WALCKENAËRA, Bl.

Walckenaëra antepenultima, sp. n. (Pl. XIII. fig. 3.)

Adult male, length $\frac{1}{23}$ of an inch.

The whole of the fore part of this minute spider is yellow-brown, the legs rather paler than the rest, and the abdomen tinged with sooty brown.

The *cephalothorax* is of ordinary form; the lateral constriction on each side at the caput is very slight, and the profile line forms a pretty even curve to the fore part of the ocular area; the caput is thus not abruptly raised above the rest. The height of the clypeus is less than one third of that of the facial space; and from behind each lateral pair of eyes a narrow somewhat three-cornered indentation runs backwards; and there is a curved (indented?) line close in front of the thoracic junction.

The *eyes* are small and form an area nearly as long as it is broad at its fore extremity. Those of the fore central pair are very minute, contiguous to each other, and (with those of the two lateral pairs) form a curved line whose convexity is

directed forwards. Those of the posterior pair are separated from each other by slightly more than an eye's diameter, this interval being less than that which divides each from the hind lateral eyes on its side.

The *legs* are rather slender, not very long, thinly clothed with fine hairs; and their relative length appears to be 1, 4, 2, 3.

The *falces* are not very strong, moderately long, vertical, and a little divergent at their extremities.

The *palpi* are short, the radial and cubital joints about equal in length; but the former is much the strongest; its fore part on the upperside is rather produced; and its extremity is indented, leaving two small points or projections, of which that on the inner side is longer, stronger, and more obtuse than the other. The digital joint is rather large, of a somewhat roundish form, rather flattened or truncate at its fore extremity. The palpal organs are not very complex, consisting chiefly of two rather strong reddish yellow-brown, curved, continuous processes. A long slender, tapering, black, filiform spine runs from the inner side beneath and round the margin, and across the fore extremity of the digital joint, projecting rather prominently from the outer extremity, its fine thread-like point in contact with some whitish membrane.

The *maxillæ* and *labium* are of normal form, and call for no special notice.

The *sternum* is large, considerably convex, and very glossy.

The *abdomen* is oval, very convex above, and glossy; it had (so far as I could see) no hairy clothing, though perhaps the hairs were originally very few and fine and had been rubbed off.

A single example of this little spider was also sent to me some time ago by Dr. Ludwig Koch, by whom it was found near Nuremberg. It is allied to *Walckenaëra præcox*, Cambr., and also to *W. subitanea*, Cambr., and to *Erigone pallens*, Cambr., but may easily be distinguished by the position of the eyes, the form of the radial joints of the palpi, and the structure of the palpal organs.

Walckenaëra orbiculata, sp. n. (Pl. XIII. fig. 2.)

Adult male, length $\frac{1}{18}$ of an inch.

The cephalothorax, legs, palpi, and falces of this spider are of a yellowish hue, slightly tinged with brown; the cephalothorax is margined by a fine black line, and the tibiæ and metatarsi of the first pair of legs (with the tibiæ of the second pair, which are less deeply tinged) of a deep yellow-brown hue;

the abdomen is of a dull drab colour, slightly suffused with sooty brown.

The *cephalothorax* is very short and of a nearly circular form, being, in fact, slightly broader than long and with no lateral constrictions at the caput; this portion is greatly elevated, the elevation directed backwards, rounded behind, flattish, sloping in front from the summit to the eyes, and marked off from the caput by a very strong, deep, tapering, horizontal indentation, which runs backwards from just above each lateral pair of eyes. The height of the clypeus is half that of the facial space; it projects forwards at its lower part, following very nearly the same general slope as that of the ocular area, along the middle of which last are a few short divergent hairs.

The *eyes* are of moderate size and seated on black spots; they form a large quadrangular figure whose length is equal to its breadth at the lower part, the upper side (formed by the posterior pair of eyes) being shortest. Those of the posterior (or upper) pair are placed on the fore part of the upperside of the cephalic eminence, and are separated from each other by a little more than a diameter's interval; and those of the lateral pairs together with the fore centrals form very nearly a straight transverse line.

The *legs* are rather long, moderate in strength (4, 1, 2, 3), and clothed only with hairs and a very few slender erect bristles or strong hairs.

The *palpi* are of moderate length. The cubital and radial joints are short and of equal length; the latter has its fore side produced into a very prominent, rather strong, tapering apophysis, whose pointed extremity is slightly hooked or abruptly bent downwards. The digital joint is rather large, of an irregular oval form, with a somewhat conical prominence near its base on the edge of the inner side. The palpal organs are tolerably complex, with two strong, obtuse, prominent corneous processes; and their extremity is furnished with a long, slender, but conspicuous black, filiform, boldly and sinuously curved spine, which, issuing from their outer side and passing beneath them, curves round and over their inner side.

The *falces* are small, straight, conical, and very strongly directed backwards towards the sternum, which is of a subtriangular form, somewhat suffused with a sooty hue, and margined with a black line.

The *abdomen* is of moderate size, oval, and projects greatly over the thorax.

This very distinct species was also sent to me from Nuremberg by Dr. L. Koch. It bears a strong resemblance at first

sight to *W. ludicra*, Cambr., but is larger *; the caput is proportionally less high; and the form and structure of the palpi and palpal organs are quite different.

Genus LINYPHIA, Latr.

Linyphia misera, sp. n.

Linyphia turbatrix, Cambr. Ann. & Mag. Nat. Hist., Sept. 1879, p. 206.

In naming this spider (*l. c. suprà*), the fact that the name "*turbatrix*" had been conferred two years before upon an arctic species (*l. c.* October 1877, p. 281) was overlooked; it becomes therefore necessary to rename the British species, upon which the name "*misera*" is now conferred.

List of Spiders.

Auletta excavata, sp. n., p. 258, Pl. XIII. fig. 1.
Walckenaëra orbiculata, sp. n., p. 260, Pl. XIII. fig. 2.
Walckenaëra antepenultima, sp. n., p. 259, Pl. XIII. fig. 3.
Linyphia misera, sp. n., p. 262.

EXPLANATION OF PLATE XIII.

Fig. 1. *Auletta* (g. n.) *excavata*, sp. n., p. 258. *a*, spider, enlarged; *b*, ditto, in profile, without legs or palpi; *c*, ditto, from above; *d*, maxillæ, labium, and sternum; *e*, genital aperture; *f*, natural length of spider.

Fig. 2. *Walckenaëra orbiculata*, sp. n., p. 260. *a*, spider, enlarged; *b*, ditto, in profile, without legs or palpi; *c*, caput and falces, from in front; *d*, right palpus, from in front on the inner side; *e*, natural length of spider.

Fig. 3. *Walckenaëra antepenultima*, sp. n., p. 259. *a*, outline of spider, from above, without legs or palpi; *b*, ditto, in profile; *c*, caput, from above and behind; *d*, left palpus, from in front; *e*, ditto, from above, in front and rather sideways; *f*, natural length of spider.

XXVIII.—*Ninth Contribution to the Knowledge of the Fauna of Madagascar* †. By Dr. ALBERT GÜNTHER, F.R.S.

THE following new species of reptiles were obtained, with many others previously described, by the Rev. Deans Cowan,

* Though, from the shortness of the cephalothorax and the projecting of the abdomen so much over it, the spider is in reality no longer than *W. ludicra*, Cambr.

† 7. "Description of a new Snake from Madagascar," Ann. & Mag. Nat. Hist. 1873, xi. p. 374.

8. "Seventh Contribution to the Knowledge of the Fauna of Madagascar," *ibid.* 1881, vii. p. 357.

in Eastern Betsileo, more especially at Arkafana. The collection contained also large series of *Gongylus splendidus*, *Chamæleon O'Shaughnessii*, *Chamæleon brevicornis* (with which *C. gularis* is identical), *Sanzinia madagascariensis*, &c.

Gongylus macrocercus.

Supranasal shields narrow, in contact with each other. Rostral shield with the upper margin straight. Frontal broad, single, with a straight posterior margin. Vertical large, bell-shaped, narrower in front than behind, with a shallow notch in the middle of its hind margin, the small central occipital fitting into the notch. One pair of occipitals. Nostrils in a notch of the rostral shield; postnasal only one fifth the size of the loreal. Seven upper labials, the fourth larger than the third, and situated below the eye. Anterior lower labial rather narrow, succeeded by a single mentale, which is rather broader than long; seven lower labials.

Eyelids scaly; ear-opening small, round. Body surrounded by twenty-seven, twenty-eight, or twenty-nine longitudinal series of scales. There are from seventy-three to seventy-seven transverse series of scales between the mentale and the vent; the body therefore is slender.

Four preanal scutes, the two central ones being the largest.

Fore limbs small, reaching but little beyond the ear-opening when laid forward. Toes short, the third and fourth equal in length. The hind limb and toes short, the fifth toe longer than the second, the fourth and fifth longer than the third. Upper parts brown, finely mottled with darker; lower parts whitish.

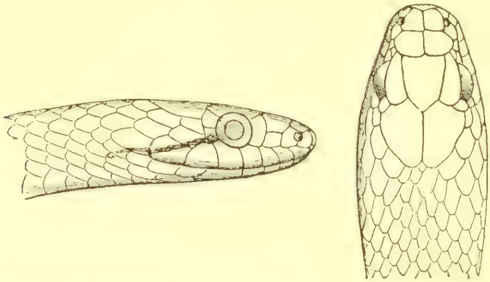
	millim. A.	millim. B.
Distance of the snout from the eye	5;	4·5
" " " ear-opening..	13;	12·5
" " " fore limb ..	27;	23
" " " vent	90;	92
Length of the tail	150;	(broken)
" " fore limb..................	15;	12
" " third front toe	3·5;	2
" " hind limb	25;	20
" " fourth hind toe	9;	5

Several specimens from Eastern Betsileo.

Ptyas infrasignatus.

Head moderately broad and high, distinct from neck, with the snout not elongate. Body rather elongate. Tail of moderate length. Eye rather large. Rostral shield a little

broader than high, scarcely reaching the upper surface of the head. Anterior frontals half the size of the posterior. Ver-



tical rather broad, with the lateral margins convergent, equal in length to the anterior. Occipitals rather small. One loreal shield only, square; one preocular, extending onto the upperside of the head, but not reaching the vertical. Two postoculars. Eight upper labials, the fourth and fifth entering the orbit. Temporals scale-like, 2 + 2 + 3. Scales lanceolate, much imbricated, smooth, in nineteen rows. Ventrals without any keel, 156–160; anal bifid, subcaudals 69–72. The maxillary teeth slightly increase in length posteriorly; but the hindmost is considerably larger than the others, and there is no vacant space between it and its predecessor.

Brownish olive above, with an indistinct lighter line from each occipital along each side of the anterior half of the body; the lower parts are whitish or reddish, with numerous small blackish spots; these spots have a tendency towards forming regular longitudinal series, three bands being thus formed in one of our specimens, one along the middle and one along each side of the belly. An oblique black stripe runs from the eye to the angle of the mouth.

The largest of three specimens is 37 inches long, the tail measuring 8 inches.

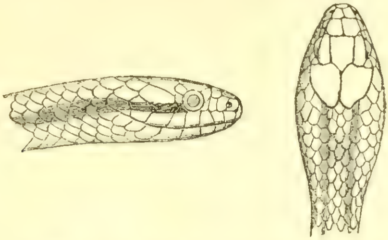
Arkafana, Eastern Betsileo.

Dromicus sexlineatus.

Scales in seventeen rows; body and tail moderately slender; ventrals 146, 148, 150; anal bifid, subcaudals 79, 76, 75. Head rather small, eye of moderate size. Vertical large, as long or nearly as long as an occipital. Loreal higher than long, two pre- and two postoculars. Eight upper labials, the fourth and fifth entering the orbit; temporals 1 + 2 + 3, the anterior in contact with the lower postocular only.

Dentition diacrantherian. Upper parts dark brownish

olive, with six black longitudinal bands, of which, however, two or more may be indistinct or disappear altogether. The



bands of the middle pair are separated by the three median dorsal series of scales, narrow, and frequently absent. The upper lateral band commences from the lower postocular, and passes behind into a broad band, bordering the subcaudals. The lower lateral band runs along the edge of the abdomen, and is sometimes narrow, sometimes broader. Lower parts whitish, with more or less numerous blackish spots, the spots being much more developed in the female than in the male.

Three specimens from Eastern Betsileo, the largest 24 inches long, the tail measuring $6\frac{1}{2}$ inches.

Dromicus macrocercus.

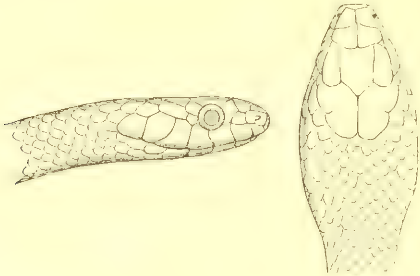
Extremely similar to *D. sexlineatus*, but much more elongate and slender. Scales in seventeen rows; ventrals 156, 156, 159; anal bifid; subcaudals 153, 139, 152. Head rather small, eye of moderate size; vertical not quite so long as occipital; loreal square; one pre- and two postoculars. Eight upper labials, the fourth and fifth entering the orbit; temporals $1+2+3$, the anterior in contact with the lower postocular only. Dentition diacrantherian. The coloration is the same as in *D. sexlineatus*, with the exception that the two median dorsal bands are scarcely indicated.

Three specimens from Eastern Betsileo, the largest being 42 inches long, the tail alone measuring $21\frac{1}{2}$ inches.

Tachymenis infralineatus.

Scales smooth, in nineteen series, those of the vertebral series not enlarged. Ventrals 186; anal entire; subcaudals 62. Head moderately broad, depressed; loreal subtriangular, as high as long; one preocular, extending onto the upperside of the head, but not reaching the vertical. Two postoculars. Seven upper labials, the third and fourth entering the orbit; temporals $1+2+3$, the anterior in contact with both postoculars. None of the anterior maxillary or palatine

teeth are enlarged; but the hindmost of the upper jaw is distinctly the largest and grooved.



Upper parts greyish olive, with a blackish median line along the posterior part of the trunk and of the tail. A similar but less distinct line runs along the outer edge of the subcaudals and posterior ventrals. An oblique blackish line from the eye towards the angle of the mouth. Lower parts whitish; anteriorly with some blackish specks, which congregate and form a well-defined narrow black band along the middle of the belly and the tail.

One specimen from Eastern Betsileo is 31 inches long, the tail measuring 6 inches.

XXIX.—*Some Sponges from the West Indies and Acapulco in the Liverpool Free Museum described, with general and classificatory Remarks.* By H. J. Carter, F.R.S. &c.

[Plates XI. & XII.]

In the following report of Sponges from the West Indies and Acapulco, collected for the Liverpool Free Museum by the Rev. H. H. Higgins, M.A.*, and Capt. W. H. Cawne Warren respectively, I propose to identify those which are already known, and to name and describe those which hitherto have not been published, availing myself at the same time

* Mr. Reginald Cholmondeley, of "Condover Hall," Shrewsbury, having chartered the yacht 'Argo' for a cruise in the West Indies during the winter of 1876–77, kindly offered to take a naturalist with him on behalf of the Liverpool Free Museum, upon which the Rev. H. H. Higgins, M.A., solicited by the committee of the museum, undertook this office.

of this opportunity to couple with these descriptions general and classificatory remarks, aided by descriptions and references to species in the British Museum and elsewhere which will best illustrate the subject, thus endeavouring to heap up still more matter for some one to embody in a 'Manual of the Spongida,' based, if he should think fit, on my "Notes Introductory to the Study and Classification of the Spongida" ('Annals,' 1875, vol. xvi. p. 1, &c.), since it is useless for me to commence a work of this kind now, which I can never expect to complete. Had I had twenty years ago the amount of knowledge of the Spongida which the opportunities and time of the last twenty have given me, I might have done this myself, and more; but as it is, it must be left to the next generation.

I had hoped to find a "key" in the collection of sponges from the West Indies to those described and illustrated in the 'Spongiaires de la Mer Caraïbe,' published in 1864 by MM. P. Duchassaing de Fonbressin et Giovanni Michelotti (Natuurk. Verh. Holland. Maat. te Haarlem, vol. xxi. 4to, with twenty-five coloured plates); but that hope has not been realized, since the work is so full of errors, typographical and others, the descriptions so incomplete, and the representations so coarse, that I have hardly ever referred to it without vexation, still more increased by the evidence that its otherwise rich contents must thus, for the most part, for ever remain unavailable, just as many of the illustrations of the Spongida in Savigny's 'Zoology of Egypt,' which, although so exquisite that one can almost see in them the objects themselves, are, for want of accompanying descriptions, rendered utterly useless.

For instance, in the 'Spongiaires de la Mer Caraïbe' we have the generic term "*Thalysias*" spelt in four different ways, viz. as "*Talysias*" at p. 24, "*Halysios*" at p. 76, "*Thalisias*" at p. 82, "*Thalysias*" at p. 84; and after all, in Dr. de Fonbressin's pamphlet of 1870, entitled a 'Revue des Zoophytes et des Spongiaires des Antilles' (where we in vain look for an apologetic explanation of the unsatisfactory way in which their 'Mémoire' on the Spongida was published) the same term is spelt "*Thalysios*" (p. 38)*; while in no instance, beyond the term "aciniform," is the spicule either delineated or described, although the authors, in their historical sketch at the commencement of the memoir (p. 11), manifest

* Hereafter the two works of de Fonbressin and Michelotti above mentioned will be referred to under the abbreviations of "de F. et M." and "Revue" respectively.

an acquaintance with both Dr. Bowerbank's and Dr. Oscar Schmidt's works!

Now, as it is essential for recognition that the microscopy and spiculation of each sponge should accompany it, if not in illustration, at least in description, so it is evident that in the absence of this alone, to say nothing of the shortcomings of the publication generally, the 'Spongiaires de la Mer Caraïbe' must for ever remain a kind of "Eldorado," in which there are a number of good things, but no one can get at them.

Having thus introduced the subject, I will now proceed to a description of the sponges, which will be arranged in accordance with my classification, beginning with

Order I. CARNOSA.

Family 2. **Gumminida.**

Chondrilla nucula, Sdt.

This flesh-like sponge seems to grow most abundantly all over the West-Indian seas and upon every thing submarine with which it comes into contact. In many places, as at Puerto Cabello, the specimens have partly-enclosed fragments of sedge (*Spartina*), much as leaves of grass still green are seen to pass through the pileus of an agaric, thus indicating great rapidity of growth in either instance. Perhaps the most remarkable features in *Chondrilla nucula* are its contracting to a very small size when dried, and swelling out to a comparatively large one when soaked in water—a property in the officinal sponge with which we are familiar; but this is fibrous, whereas *Chondrilla nucula* when dry is nearly as hard as wood, and when wet presents the toughness, consistence, and elasticity of india-rubber, with the softness of gelatine; while, like the officinal sponge again, it may be dried and soaked repeatedly without apparently undergoing any deterioration in structure.

Order II. CERATINA.

Family 1. **Luffarida.**

Luffaria cauliformis, n. sp.

Cauliform, cylindrical, round, solid, long; simple or branched irregularly; erect, straggling, or repent; rising from a contracted base of attachment, terminating in a diminished round point, swelling out slightly between; uniting with each

other where in contact, and with all other kinds of objects in their course. Stiff, but fragile. Colour black. Surface uniformly reticulate in relief, covered with black dermal sarcode except where the vents, more or less linearly arranged in two rows, present themselves on opposite sides of the cylinder. Internal structure fibro-reticulate, tympanized with black sarcode in the interstices; fibre round, anastomosing, of a clear golden amber-colour, uniformly cored or axiated with a small but distinct pith of greyish-white microgranular substance; rigid but fragile, contrasting strongly in its bright colour with the black sarcode; diminishing in size as it extends upwards and outwards from the centre to the circumference, where it ends in simple branches, covered as before stated, unless waterworn by the dermal sarcode. Size of largest caulis or stalk about 18 inches long by half an inch in diameter in its widest part.

Hab. Marine. Attaching itself to all objects with which it may come into contact while growing.

Loc. Antigua, Nassau.

Obs. The black colour of the sarcode, rigid although fragile fibre, with its distinctly and uniformly axiated character, terminating on the surface in simple branches instead of knotted aggregations, chiefly separate the cauliform *Luffariæ* from those of the same form and appearance among the *Aplysinæ* that will hereafter be described.

Luffaria cauliformis, var. *rufa.*

The same as the foregoing, only of a light brown-red colour.

Loc. Antigua.

Luffaria cauliformis, var. *elongo-reticulata.*

The same as the last, but with the meshes of the fibro-reticulate skeletal structures more elongated and more obliquely directed upwards and outwards from the centre. Colour grey.

Loc. Nassau.

General Observations.

The cauliform species of *Luffaria*, like the "creeping *Cereus*" (*C. flagelliformis*), are all solid; and of course the vents appear on the surface, as in the cauliform digitate *Chalina*; while another kind, although not exactly "cauliform," is long, tubular, and hollow, ex. gr. *L. fistularis* auctt. and *L. Archeri*, Higgin, in which, of course, all the vents open

into the interior, which thus forms a "cloaca." I use the words "of course" advisedly, because the vents in all cases must open in these ways respectively.

Family 2. **Aplysinida.**

Aplysina aerophoba, Nardo.

Several specimens (see Schmidt, in Spong. Adriatisch. Meeres, p. 25, and type specimens in the British Museum).

Loc. Antigua.

Aplysina compressa, n. sp.

(Fragment.) Compressed, curved, flat, flabelliform, thinning out towards the upper or unbroken margin. Firm in the dried state, black and shining, like "satin." Surface wrinkled by irregular polygonal divisions, in which the ridges are much more elevated on one (? the outer) side than on the other (? the inner) one, where the vents are. Fibre concealed by the black sarcode, except at the broken edges and waterworn parts, where it presents an opaque yellow colour, contrasting strongly with the rest of the sponge. Size of the fragment $4 \times 2 \times \frac{1}{2}$ inch in its greatest dimensions.

Hab. Marine.

Loc. Long Key Island, Nassau.

Obs. This looks like a fragment of a once flabelliform or vase-like structure. As I have before stated, the chief difference between this kind of *Aplysina* and *Luffaria* is more or less empirical, being one of degree in which the core of the fibre of the former exceeds in thickness the wall of the transparent kerasine cylinder which surrounds it, while in the latter it is the opposite. Generally too, perhaps, the growth of this kind of *Aplysina* is more massive, sessile, and spreading, while that of *Luffaria* is more cauliform and ascendant. In the two species, viz. *A. carnosa* and *A. corneostellata*, however, and in the mixed form, *A. capensis* ('Annals,' 1881, vol. viii. p. 110), the surface is covered with minute hair-like filaments, which are the terminations of the internal fibrous structure. There is a quadrilateral compressed specimen of this kind (apparently a fragment too) in the British Museum (no. 177, "5 *c*"), where the vents, which are large and on the margin, represent a Pandean-pipe arrangement.

Aplysina cauliformis, n. sp.

Cauliform, cylindrical, round, solid, long; simple or branched irregularly; erect, straggling, or repent, rising

from a contracted base of attachment terminating in a diminished round point, swelling out slightly between; uniting with each other where in contact, and with all other kinds of objects in their course. Texture resilient. Colour light pinkish brown. Surface even or subpenicillate. Vents round, numerous, situated linearly or flute-like in two rows on opposite sides of the stem, or more or less irregularly scattered over it. Structure essentially fibrous; fibre simple, rather flaccid, with indistinct granular axis, reticulated, diminishing in size upwards and outwards from the centre to the circumference, where it is gathered together into subpenicillate projecting knots; void of foreign bodies throughout. Size of longest stalks, of which there are many, about 1 foot long and $\frac{1}{4}$ to 1 inch in diameter.

Hab. Marine. Growing upon hard objects, often in conjunction with *Polytherses* and *Luffaria cauliformis.*

Loc. Nassau.

Obs. The absence of foreign bodies in the fibre, flaccid character, and brownish-pink colour, so far unite this sponge to *A. carnosa*, Sdt., and *A. corneostellata*, Carter, that, however different it may be in other respects, these kinds of *Aplysinæ* appear to be its nearest allies; for, although the subpenicillate knot-like terminations of the fibre on the surface are without the "hair-like filament" of *A. carnosa* &c., still they are a nearer approach to it than those of the Luffarian species last described, where there are none. *Aplysina cauliformis* appears to be the same as *Callyspongia tenerrima*, de F. et M. (p. 57, pl. x. fig. 3).

Aplysina longissima, n. sp.

Whip-like, cauliform, cylindrical, round, solid, long; simple or branched scantily and irregularly; erect, rising from an expanded incrusting base, diminishing gradually to a round point. Very rigid and resilient. Colourless or grey. Surface uniformly even towards the free extremity or youngest part, becoming covered with star-like knots of the fibre, increasing in size and prominence towards the base, where this structure is strikingly beautiful. Vents large, round, and scattered over the expanded base, becoming less evident upwards. Structure essentially fibrous; fibre simple, rigid, stiff, with indistinct granular axis, reticulated, diminishing in size upwards and outwards from the centre to the circumference, where it is gathered together in the star-like knots mentioned; void of foreign bodies throughout. Size of largest specimen 27 inches long by half an inch in diameter: expanded or incrusting base about 2 inches square.

Hab. Marine. Growing upon hard objects.

Loc. Nassau.

Obs. The same remarks with reference to classification apply to this as to the last species, from which it differs chiefly in being much more rigid, colourless, and ornamented on the surface, especially towards the lower part, with a much more beautiful development of the star-like structure, in which the terminal knots of the internal fibre become absolutely conoidal from their prominence.

Aplysina (*Spongia*, de F. et M.) *fenestrata.*

Massive, sessile, lobate, hollow; lobes erect, amorphous or conical. Tissue flexible, resilient. Colour black, becoming brown where waterworn. Surface polygonally reticulated, tympanized with black glistening sarcode in the interstices, which are bordered by projections of the subdermal fibre. Vents large, on the prominent parts of the body. Internally fibrous, elastic, columnar, like that of honeycomb, irregularly prismatic, about half an inch thick, forming a perpendicular structure between the surface and the internal cavities, whose shape is therefore more or less indicated by the form of the mass externally. Fibre stiff, flexible, of a deep amber-colour, cored indistinctly with a granular axis, void of all foreign objects; forming a reticulated line in each angle of the prismatic structure, interunited by transverse filaments, which terminate on the surface in the way mentioned. Size of largest specimen about $6 \times 4 \times 2$ inches.

Hab. Marine.

Loc. Long Key Island, Nassau.

Obs. With kerasine flexible fibre void of all foreign objects in the core, which is indistinctly granular, we have no other order for the reception of this species but the Ceratina and the family Aplysinida; still, having evidently been described and figured by de F. et M. under the name of "*Spongia fenestrata*" (p. 36, pl. iii. fig. 7), their specific although not their generic name has been retained. British Museum, Nos. 179 and 484.

Order III. PSAMMONEMATA.

Family 1. **Bibulida.**

Spongia officinalis auctt.

Massive, sessile, globular, or lobed; lobes erect, conoid, each terminating in a large oscule. Texture resilient, firm. Colour purple-black above, becoming colourless below.

Surface uniformly and finely reticulated in relief, on account of the dermal sarcode subsiding on the subjacent fibrous structure. Vents numerous, large and scattered, chiefly on the prominent parts. Internal structure finely cellular, arising from the sarcode tympanizing the meshes of the fine skeletal fibro-reticulation; traversed by the branches of the excretory canal-system, which terminates in the vents mentioned; fibre for the most part tough, translucent, resilient, and yellowish in colour, terminating on the surface in pointed knots or tags, cored with a little sand, from which the psammonematous filament, otherwise difficultly distinguishable, may be traced internally. Largest specimen, which is the subglobular one, $6 \times 3 \times 5$ inches.

Hab. Marine. Growing on hard objects.

Loc. Puerto Cabello.

Obs. Having in my possession a specimen of the so-called "best Turkey sponge" of commerce, which was obtained in the Black Sea and preserved in spirit while fresh, I am enabled to compare it satisfactorily with the West-Indian specimens, of which there are both dry and fresh ones, and thus to state that there is no specific distinction between the two. The coarser forms from the Mediterranean, called in commerce "honeycomb sponges," are also to be found in the West Indies; and, indeed, the two kinds appear to me to occur together at the Cape, the Mauritius, in the sea around S.W. Australia, and all over the world; but not being so large, or so plentiful, or of such a convenient shape as in the Mediterranean, their occurrence for the most part is disregarded in a commercial point of view, although a good collection from different localities would form a most interesting zoological demonstration of their comparative differences. Meanwhile the vitality of these sponges is so great that they are now grown from "cuttings" in the Adriatic for commercial purposes. When a section of the West-Indian sponge in its dried state is made, the internal structure presents a light brown colour, which contrasts strongly with the dark purple-black thin layer of the dermal sarcode; and this is the case also with the coarser kinds. It is very probable that there are degrees of fineness between the "best Turkey sponge" and the "honeycomb" ones; but to describe these would be more troublesome than useful in a zoological point of view.

Family 2. **Hircinida.**

Hircinia caracasensis, n. sp.

Massive, sessile, globular, with a tendency to rise into

lobes. Texture firm. Colour dark purple above, becoming brown and colourless below. Surface uniformly reticulated, wherein the knots of the reticulation and the intervening lines of the subjacent fibro-skeletal structure are rendered more or less in relief by the extent to which the dark dermal sarcode subsides between them, thus presenting a polygonally-divided area, in which the larger divisions are marked by the salient points of the knots, often filamented, and a smaller structure of the same kind, but more delicate and soft, occupies the interstices. Vents numerous, large and small, scattered. Internal structure uniformly cellular, formed in the way stated in the last species; traversed by the branches of the excretory canal-system, which ends in the vents mentioned; fibre kerasine, resilient, cored to a great extent with foreign bodies (sand-grains &c.). Size of specimen, which is subglobular, about $8 \times 5 \times 4$ inches.

Hab. Marine. Growing on hard objects.

Loc. Puerto Cabello and Nassau.

Obs. By comparing this with the last species, we come to the conclusion that the chief differences arise from the fibre being coarser, more generally cored with foreign bodies (sand-grains &c.), and the structure less compact than that of *Spongia officinalis*, wherein the bibulous property on this account so far exceeds that of even the finest-structured *Hircinia* that the latter is of course never used for domestic purposes. It is possible that this species may be represented by de F. et M. in their figure 4, pl. iv., under the name of "*Spongia lacinulosa*," if the surface-filaments thereon delineated are to be identified with those often observed on the waterworn parts of *Hircinia caracasensis*.

Polytherses, de F. et M.

There are several specimens of this so-called sponge, which, indeed, is no sponge at all, but a *Hircinia* in which the sarcode has been mysteriously replaced by the parasitic filament for which I have proposed the name of "*Spongiophaga communis*." I say "mysteriously," because no one yet has been able to follow the transformation or development of the parasite, or determine, if indeed conjecture, what it is; for an account of which, so far as is known, together with an illustration, I must refer the reader to my paper on the Parasites of the Spongida ('Annals,' 1878, vol. ii. p. 165).

It attacks *Hircinia* of different degrees of fineness of structure in all parts of the world, and so simulates the sponge itself that de F. et M. took it for one, and called it "*Poly-*

therses"—since it is exceedingly plentiful in the West-Indian seas, growing in some parts where the water is hardly a metre deep (de F. et M., "Revue," p. 37), and yet I found a specimen equally affected by it which was dredged near Cape St. Vincent on board H.M.S 'Porcupine' in 374 fathoms. Although, in most instances, the whole of the sarcode is destroyed, still in many this is only partially the case, while, of course, there are also many instances wherein there is no trace of the filament at all to be seen, and the *Hircinia* remains so far intact. Lastly, the transformation goes on so gently and yet so completely that the delicate white lace-like reticulation which is often seen in the dermal sarcode tympanizing the polygonal divisions between the projecting points of the fibrous structure on the surface of the *Hircinia* is frequently left when every particle of sarcode that was in contact with it has disappeared, thus remaining on a tympanizing membrane formed by the filaments instead of the sarcode. This lace-like reticulation arises from the delicate fibro-reticulation in the dermal sarcode, before mentioned, attaching to itself microscopic objects of all kinds, which sometimes goes on to such an extent as to produce a continuous incrustation, in which case, of course, the reticulated structure becomes obscured.

Group 16. Arenosa.

Dysidea tubulosa, n. sp.

Tubes erect, grouped in juxtaposition; fragile. Colour white, chiefly from being densely charged with a small white, filiform, branched coralline (*Jania*). Tubes $1\frac{1}{2}$ inch high and $\frac{1}{4}$ inch in diameter when dry.

Hab. Marine.

Loc. Nassau.

Obs. This, in description and figure, corresponds with de F. et M.'s *Terpios jania* (p. 101, pl. xxii. figs. 8, 9), in which the spicules are said to be "aciniformes," whatever this may mean; but it is not the case, in particular, with our specimen, where the variety of different forms of fragmentary sponge-spicules and other foreign bodies at once testifies to its nature; hence the name above given. As we cannot assume that the *Jania*, when growing by itself, has this tubular form, so we cannot assume that it belongs to the *Dysidea* alone; hence it may be produced by the two growing together *pari passu*; although another instance of this kind was dredged in the harbour of Acapulco by Capt. W. H. Cawne Warren, in which the sponge is *Reniera fibulata*, Sdt., in combination

with the same species of *Jania*, forming a *globular* sessile mass with large crevice-like vents.

Of course, there is no alliance between these specimens and de F. et M.'s species *Terpios fugax*, which will be described hereafter.

Order IV. RHAPHIDONEMATA.

Family 2. **Chalinida.**

Chalina rubens, Pallas.

Massive, lobate, sessile, erect or flat, convex, repent, incrusting, lobes often extended into long processes characterized by large round vents. Texture firm, resilient. Colour dark or light crimson-red, often reddish brown when fresh, light brown-grey to white after exposure on the shore. Surface covered with a fine fibro-reticulation interrupted only by the vents. Vents large, round, numerous, elevated at the margin, scattered generally over the mass, or more or less confined to particular parts, especially in the cylindrical erect forms, where they present a broken linear arrangement on opposite sides of the column. Internally composed of uniformly reticulated fibrous structure, much coarser but less dense than that of the surface; traversed by the branches of the excretory canal-system, which terminates at the vents mentioned; fibre resilient, kerasine, cored with proper spicules. Spicule of one form only, viz. acerate, smooth, slightly curved, fusiform, sharp-pointed, about 50 by $\frac{2}{3}$-6000th inch in its greatest dimensions* (Pl. XI. fig. 7), more confined to the fibre than to the sarcode. Size of largest specimen about 9 inches high and 5 inches in diameter at the base, with lobes 1 to 2 inches thick.

Hab. Marine. Growing on hard objects.

Loc. Nassau. Long Key Island.

Obs. This sponge has been known for a very long time under the name of *Spongia rubens*, given to it by Pallas (Elench. Zoophytorum, p. 389. no. 238), = *S. digitata*, Esper, tab. 50, = *S. arborescens*, Lam. (An. s. Vertèb. vol. ii. p. 374, no. 98), and last? = *Amphimédon*, de F. et M. (p. 78). Variable, however, as the form and colour in different specimens may be, the prevailing character of the species, which appears to be very plentiful in the West Indies, growing especially about the branches of *Millepora alcicornis*, may be traced

* The measurements will be chiefly given in 6000ths of an inch, to accord with the delineations in the Plates. See "Note" at the commencement of the "Explanation of the Plates."

throughout, while the spiculation above stated is always the same.

It is often accompanied in its repent-incrusting form by *Thalysias carbonaria*, de F. et M., = *Spongia carbonaria*, of Lamarck, who states that it is found "enveloppant de grandes portions du *Millepora alcicornis*" (vol. ii. p. 357. no. 20); but the friable structure of the latter, as well as its colour, although in every other respect like *Chalina rubens*, distinguishes the two; while the lighter-coloured species of *Thalysias* are still more compact and friable, although still with the same spiculation and structure. Yet *Thalysias* has been placed by me in the order Holorhaphidota, and *Chalina* in that of the Rhaphidonemata! simply because the absence of friability in the latter arises from the kerasine element in the fibre preponderating over the spiculiferous core, while in the Holorhaphidota it is the opposite.

This is the case with the British species *Halichondria simulans*, Johnst., whose varieties are so numerous that he calls it "polymorphous." Indeed *H. simulans* is not unlike a British representative of the West-Indian *Chalina rubens*. So it is with a sponge similar to *H. simulans* at Ceylon (? Hartog Is., W. Australia) and Port Elizabeth respectively, but with a bihamate flesh-spicule, in which the former has the resiliency of a *Chalina* and the latter that of an *Isodictya* (numbered respectively in the British Museum 106, registered 59. 2. 28. 36, and 202, registered 71. 5. 12. 1).

Chalina rubens also exists in the sea about S. Australia; but the specimen which I have is of a light yellow colour; however, it seems, like the West-Indian specimens, to come nearer to the British species *Halichondria palmata*, Johnst., which I have taken for the type of the group Palmata (viz. no. 2) in my order Rhaphidonemata.

Family 2. **Cavochalinida.**

Tuba lineata, de F. et M. (p. 74).

Vase-shaped, flabelliform, compressed or bivalvate, with the halves, which are thin and separate, in close approximation, but marginally united on one side only and at the base of the *Pecten*-like form. Size about 9 inches long by 6 inches high. (Spicule, Pl. XI. fig. 4.)

Loc. Dominica.

Tuba digitalis, de F. et M. (p. 49, pl. viii. fig. 2).

Vase-like or tubular, patulous, proliferous, consisting of several individuals of different sizes grouped together, so as to

form an irregular lobate mass. Orifice ciliated. Differing from the species last mentioned, viz. *T. lineata*, in the absence of the fine dermal reticulation usually characterizing these sponges, which is replaced by a penicillate surface formed of prolongations of the tissue, between which are an equal number of holes, now, like the vents, opening into the interior, but probably in the fresh state covered by a dermal fibro-reticulation supporting the sarcode in which the pores were situated. Largest specimen, which is that described, 4 inches high by 4 inches thick. (Spicule, Pl. XI. fig. 5.)

Loc. Nassau.

Tuba armigera, de F. et M. (p. 43, pl. viii. fig. 3).

Irregularly cylindrical, crooked, solid, repent, long, simple or branched, scantily furnished with prolongations of the tissue in the form of coarse spines. Surface covered with the usual fine, smooth, dermal fibro-reticulation. Vents large and numerous. Largest specimen about 8 inches long by $\frac{1}{2}$ to 1 inch in diameter. (Spicule, Pl. XI. fig. 6.)

Loc. La Guyra.

Obs. The group of sponges to which the foregoing three species belong appears to me to be more developed in the West-Indian seas than in any other part of the world, judging from the amount and variety of them in the British Museum. They are for the most part aculeated, and all hollow; all are composed of resilient fibre, and the fibre cored with a variable amount of spicules, in which, as in *Chalina rubens*, the kerasine element greatly predominates. The spicule is of one kind only in all, and this for the most part smooth, curved, fusiform, and sharp-pointed, viz. the typical "acerate," varying somewhat in size and form, although still always "acerate" (Pl. XI. figs. 4, 5, 6). The colour, when dry, is always tawny yellow, and the resiliency that of sponges in which the kerasine element preponderates over the amount of spicules, as just stated. To this group de Fonbressin and Michelotti have given the name "*Tuba*" (p. 44), but, as usual, have not made any allusion to the spicule; their division of it, however, into three sections seems to be so reasonable that I will here insert them, viz.:—

"Section 1.

"Orifice du Siphon fortement cilié.

"*a.* Tissu fin, surface extérieure munie de processus spiniform-encroûtés.

"*b.* Tissu grossier, surface extérieure hérissée de pinceaux de fibre non-encroûtés.

"Section 2.

"Orifice du Siphon plutôt frangé que cilié.

"Section 3.

"Orifice nu, c. a. d. n'offrant ni cils ni pinceaux bien formés, ni frangés."

To these sponges Schmidt has given the name of "*Siphonochalina*," and, after enumerating several of them (Spongf. Atlantisch. Gebiet. p. 34), adds that they present "an unbroken line of varieties."

The groups Spinifera, Aculeata, Subaculeata, and Ciliata, in my classification, were intended to receive the whole of de F. et M.'s genus *Tuba*; the three latter in the second family, viz. Cavochalinida, and the former in the first family, viz. Chalinida; hence *Tuba armigera*, being *solid*, should have been inserted next to *Chalina rubens* among the Chalinida, but has been placed here for convenience. A few words, however, will show how the solid form of *Chalina* may pass into the hollow one. Thus, when the cylindrical stem is solid and erect, the vents are on the surface or outside; while if the stem is repent and the vents grow upwards into hollow tubes at the expense of the repent portion, then the vents of the erect portions open into the interior or inside of the tubes, and the specimen thus becomes a *Cavochalina*; but if the vents of the repent portion do not grow upwards in this way, then the species remains solid, increases in size, and of necessity comes into the first family, or that of solid *Chalinæ*; hence our *Tuba armigera* falls into the group Spinifera.

Tuba acapulcaensis, n. sp.

Massive, globular, lobed, erect, consisting of a group of short branches anastomosing with each other as they grow up into the form mentioned, more or less extending beyond the circumference, aculeate, solid, or hollow. Consistence resilient. Colour different shades of fawn. Surface of the branches more or less aculeated, aculeations consisting of spiniform prolongations of the fibrous structure. Vents on the surface of the solid branches, opening into the interior in the hollow or tubular ones. Internal structure fibrous, resilient; fibre chiefly kerasine flexible, cored or axiated by the spicule of the species in different degrees of plurality. Spicules of one form only, viz. acerate, variable in size, chiefly confined to the fibre. Size of largest specimen, of which there are upwards of a dozen, about 6 inches in diameter; largest branches about one third of an inch thick.

Hab. Marine. Growing on hard objects.

Loc. Harbour of Acapulco, 4–9 fathoms.

Obs. The above name and description apply to a great number of specimens of *Chalina* dredged by Capt. W. H. Cawne Warren in the harbour of Acapulco and presented to the Liverpool Free Museum. One cannot help seeing at a glance that they are all a uniformly massive, sub-branched development of the genus *Tuba*, which so abounds on the other side of the Isthmus of Panama, in the West-Indian seas, under such a variety of definite and beautiful forms. Here, in the harbour of Acapulco, so far as these specimens inform us, the growth, although extremely exuberant and equally characterized by the spiniferous prolongations of the tissue, presents a sameness which is totally devoid of any striking form. For convenience, here also the specimens with tubular and solid branches respectively have been described together. In short, after all, they are but varieties of the same fabric.

Pseudochalinica (new family).

In my order Psammonemata I have proposed the family "Pseudohircinida" for receiving all sponges that, in addition to the sand-grains &c. (foreign microscopic objects) axiating their fibre, also present "proper spicules"—that is, spicules formed by the sponge itself; but as this mixture often occurs in adult sponge-forms which rather belong to sponges characterized by the "proper spicules" themselves than by the sand-grains, it seems to me desirable that each order should have a family of this kind for the adult forms which are most characteristic of it. Thus, two instances in sponges which evidently belong to the Rhaphidonemata have come to my notice, viz. one in the solid *Chalinæ*, which I have grouped under the head of "Digitata," and the other in the hollow *Chalinæ*, which I have named "Tubulodigitata;" these I will now briefly describe under the names of *Chalina digitata*, var. *arenosa*, and *Carochalina digitata*, var. *arenosa*, respectively :—

Chalina digitata, var. *arenosa*, n. s.

Stipitate, quickly dividing pollachotomously into several cauliform branches; branches thick, round, even, solid, with vents plentifully scattered over the surface. Fibre kerasine, resilient, covered or axiated with acerate spicules, among which there are many microscopic foreign objects, sand-grains, &c. Size of specimen 15 inches long. (British Museum, no. 106**, registered 57. 1. 2. 9.)

Hab. Marine.
Loc. New Zealand and Australia.

Cavochalina digitata, var. *arenosa*, n. s.

Base of attachment irregular, subsessile, rising into a group of hollow knotted tubes, simple or branched, increasing in size towards the free ends, which are thus rendered patulous. Vents numerous, opening internally. Fibre kerasine, resilient, cored or axiated with acerate spicules, among which are many microscopic foreign objects, sand-grains &c. Size of group 10 inches high and $6\frac{1}{2}$ inches broad; free ends of tubes 1–2 inches in diameter. (British Museum no. 589, registered 72. 5. 21. 25.)
Hab. Marine.
Loc. Swan River, W. Australia.

Order V. ECHINONEMATA.

Family 1. **Ectyonida.**

Ectyon sparsus, Gray.

Of this sponge there are two specimens, of which the largest presents an irregular form about 6 inches in its longest diameter, growing upon a piece of an old coral detritus, covered with *Polytrema miniaceum*.
Loc. Antigua.
Obs. This species, which I described and illustrated under the above name ('Annals,' 1871, vol. vii. p. 270, pl. xvii.), is evidently the "*Ajelas*" of de F. et M. (p. 76, pl. xv. figs. 1 and 2), and so common in the West Indies that it would be hardly possible to find a collection of sponges from thence without it. I possess a species from the Mauritius, differing only in the larger size and still greater beauty of the ornamentation on the surface of the spicule. It appears to be represented in Europe by *Clathria coralloides*, Sdt. (Spong. Adriat. Meeres, S. 58, Taf. v. figs. 10 and 11). Representations of two different species are given by Dr. Bowerbank under the name of "West-Indian sponges" (Mon. Brit. Spong. vol. i. pp. 275, 276, pl. xvii. figs. 289 and 290), called afterwards respectively *Ectyon sparsus* and *E. fascicularis* by Dr. Gray in 1867 (Proc. Zool Soc. 1867, p. 515); while Schmidt, in 1870, enumerates several species from the West Indies under the generic name of "*Chalinopsis*" (Spongf. Atlant. Gebiet. S. 59 *et seq.*, Taf. v. figs. 2 *a*, *b*, spicules only). I have not yet seen specimens from any other part of the world, although

I can hardly doubt its existence generally under the same or other representative forms.

Order VI. HOLORHAPHIDOTA.

Family 1. Renierida.

In the West-Indian collection, the Amorphina are represented by the ubiquitous *Halichondria panicea*, Johnst. (spicule, Pl. XI. fig. 8); the Isodictyosa by the British species *Isodictya simulans*, Bk. (spicule, Pl. XI. fig. 9); and the Thalyosa by the West-Indian genus *Thalysias*, de F. et M., in a repent form of the white species *subtriangularis*. viz. *T. repens*, mihi, and the black one by *T. carbonaria*, before mentioned (spicules, Pl. XI. figs. 10 and 11 respectively).

Group 5. Fibulifera.

Fibularia massa, n. sp.

Massive, solid, lobate, beautifully reticulate, lobes ending in large vents respectively. Texture hard, but friable. Colourless when dry, ? pink or red when fresh. Surface even, regularly reticulate, interrupted only by the openings of the vents. Vents on the prominent parts large but not numerous. Internal structure also *evenly* reticulate throughout, like the surface; traversed by the branches of the excretory canal-system; fibre composed of the skeletal spicules of the species. Spicules of three kinds, viz.:—1, skeletal, acerate, smooth, cylindrical, curved, round at the ends, about 80 by 4-6000ths inch in its greatest dimensions (Pl. XI. fig. 13, *a*); 2, acerate, smooth, fusiform, nearly straight, in sheaf-like bundles when small, becoming dispersed when large; when hair-like in the form of "trichites," in bundles about 20-6000ths inch long, and when large and dispersed about 33 by 1-6000th inch in its greatest dimensions (figs. 13, *b*, *c*); 3, flesh-spicule, bihamate, smooth, simple, C-shaped, sigmoid, about 4-6000ths inch long (fig. 13, *d*). No. 1 is chiefly confined to the skeletal fibre; nos. 2 and 3 are abundantly dispersed throughout the sarcode. Size of specimen, which is only a fragment, about 4½ inches long, 2 broad, 2 high.

Hab. Marine.

Loc. Long Key Island, Nassau.

Obs. This in structure is a very beautiful species, on account of the uninterrupted regularity of its reticulation throughout, which literally is "isodictyal." The larger acerates are no doubt derived from the hair-like small ones, which, coming

from the sheaf-like bundles, thus testify to their original development in *plurality* in a cell, and subsequent enlargement in the sarcode. There is a specimen of this sponge in the British Museum, numbered 216, also supposed to come from the West Indies, which, from its weather-worn condition, appears in like manner to have been picked up on a beach. Its spiculation and structure entitle it, like the next species, to a place among the Fibulifera, the sheaf-like spicules being considered an adjunct.

Fibularia ramosa, n. sp.

Stipitate, subcylindrical, solid, simple or branched irregularly. Texture loose, light, fragile. Colour brown. Surface uniformly reticulate, ending towards the free extremity of the branches in little plumose tufts, which are the terminations of the fibro-skeleton. Structure internally plumose, radiating, fragile, composed of spiculo-fibre tympanized in its reticulation by the sarcode. Spicules of two kinds, viz.:—1, skeletal, smooth, acerate, curved, fusiform, pointed at each end, about 55 by $1\frac{1}{2}$-6000th inch in its greatest dimensions (Pl. XI. fig. 12, *a*); 2, flesh-spicule, bihamate, smooth, minute, C-shaped, sigmoid, about 4-6000ths inch long (fig. 12, *b*). No. 1 is chiefly confined to the fibro-skeleton, and 2 plentifully scattered throughout the sarcode. Size of largest stem, fragment or branch (for it is much broken up in pieces), about 7 by $\frac{3}{4}$ inch in its greatest dimensions.

Hab. Marine.

Loc. Puerto Cabello.

Obs. The delicate structure and spiculation of this species claim for it a place in the group Fibulifera, wherein the fibre is almost solely composed of proper spicules. Like the specimens of this species in the British Museum, viz. no. 206, reg. no. 41. 3. 16. 9, and no. 412, both of which come from the West Indies, it is plentifully infested by the isolated polyp (*Bergia*) on the surface.

Fibularia anchorata, n. sp.

Massive, leathery, lobed, sessile. Texture tough, resilient. Colour yellowish brown. Surface uniformly covered with a wrinkled dermal structure in relief, whose lines are rough and muricated, tympanized in the intervals by the dermal sarcode. Vents large, chiefly on the prominent parts of the lobes. Structure internally more or less cavernous, from the presence of large fenestral portions of membranous thick sarcode, which stretch across the intervals between the more compact parts; sarcode and fibre charged with the spicules of the species,

mixed with foreign microscopic objects, viz. sand-grains, fragmentary sponge-spicules, &c. Spicules of three kinds, viz.:—1, skeletal, acerate, smooth, curved, fusiform, pointed at each end, about 35 by 1-6000th inch in its greatest dimensions (Pl. XI. fig. 14, *a*); 2, flesh-spicule, bihamate, minute, simple, C-shaped, and sigmoid, about 4-6000ths inch long (fig. 14, *b*); 3, flesh-spicule, equianchorate, very minute, about $2\frac{1}{2}$-6000ths inch long (fig. 14, *c*, *d*). No. 1 is chiefly confined to the skeletal fibre, with no. 2 plentifully and no. 3 scantily dispersed throughout the sarcode. Size of specimen about 4 inches square.

Hab. Marine. Attached to *Porites furcatus*.

Loc. Antigua; Falmouth harbour.

Obs. The crumb-of-bread-like appearance and dermal structure of this species very much resemble those of *Halichondria incrustans*, while the presence of the equianchorate, which, although extremely minute, is in form also like that of this sponge, tends to increase the analogy; but the single acerate form of skeletal spicule, together with the abundance of minute bihamates, allies it more to the Fibulifera. From the variety of microscopic foreign objects present in the fibre and sarcode, it might at first be conjectured that the equianchorate, which is an exceptional occurrence, was a foreign object also; but there are several specimens of the same species in the British Museum, numbered 206 *d*, "*nn*," &c., from the West Indies, in which the same kind of anchorate is equally present; so we must conclude that it belongs to the species; and hence the designation.

The presence of foreign objects with the proper spicules gives this sponge a mixed character, which would claim for it a family, like that of the "Pseudochalinida" before mentioned, which, under like conditions, might be termed "Pseudofibularidina."

Reniera fibulata, Sdt.

Globular, massive, furnished with large patulous crevice-like vents. Densely charged with the minute coralline, *Jania*, to which I have before alluded under "*Dysidea tubulosa*" (p. 275). Dredged in the harbour of Acapulco by Capt. W. H. Cawne Warren.

Obs. The type specimen of *Reniera accommodata*, Sdt., from Cette, in the British Museum, not only contains the usual bihamates but tricurvates also (Spong. v. Algier, p. 30).

Group 6. HALICHONDRINA.

Halichondria isodictyalis, n. sp.

Massive, sessile, lobate. Consistence fragile. Colour light fawn. Surface uniformly reticulate in relief, except where interrupted by a vent. Vents scattered over the surface generally. Structure crumb-of-bread-like, reticulate, delicate, fragile, traversed by the branches of the excretory canal-system. Spicules of four forms, viz.:—1, skeletal, acuate, smooth, curved towards the blunt end, which is rather smaller than the rest of the shaft; gradually sharp-pointed, about 40 by $1\frac{1}{2}$-6000th inch in its greatest dimensions (Pl. XI. fig. 2, *a*); 2, subskeletal, a tibiella with slightly fusiform shaft and inflated ends, about 50 by $1\frac{1}{3}$-6000th inch in its greatest dimensions (fig. 2, *b*); 3, flesh-spicule, equianchorate, shaft simple, curved, arms slightly everted, about one third of the length of the shaft, 6-6000ths inch long (fig. 2, *cc*); 4, flesh-spicule, simple, C-shaped, sigmoid, bihamate, 4-6000ths inch long (fig. 2, *d*). Nos. 1 and 2, intermixed generally, are chiefly confined to the spiculo-skeletal structure, which is arranged isodictyally; nos. 3 and 4 are scattered more or less abundantly throughout the sarcode. Size of largest fragment, of which there are several (all of which appear to have come from the same mass originally, as they are all intermingled with the same species of coralline, viz. *Flabellaria opuntia*), $4 \times 3 \times 2$ inches.

Hab. Marine. Growing about and enclosing *Flabellaria opuntia* in the West Indies, or densely charged with miliary gravel at Acapulco.

Loc. Puerto Cabello and harbour of Acapulco.

Obs. The external appearance of this sponge, where it is most free from the objects among which it has been growing, is very like that of *Halichondria incrustans*; but the isodictyal arrangement of the spiculo-skeleton, the spineless acuate, and the shaft of the anchorate being simple instead of inflated above and below the middle (as in *H. incrustans*), are sufficient differences to establish a distinction, and to call for a different designation; hence the term "*isodictyalis*."

The specimens, which are charged with the miliary gravel among which the sponge has thus grown, were dredged in the harbour of Acapulco, in 4–9 fathoms, by Capt. W. H. Cawne Warren.

Halichondria pustulosa, n. sp. (Pl. XI. fig. 1, *a–g*.)

Erect, branched irregularly, branches nodose or knotted

and pustuliferous (Pl. XI. fig. 1). Consistence soft, friable. Colour faint white-yellow. Surface uniformly smooth, except where interrupted by the presence of little conical pustules puckered towards the apex (fig. 1, *a a* and *b*). Vents and pores respectively in the pustules, which are irregularly and plentifully scattered over the surface. Internal structure soft, compact towards the centre, becoming less so towards the circumference, where the pointed ends of the spicules penetrate the crust of the surface, but do not extend beyond it. Spicules of five forms, viz.:—1, skeletal, long, acuate, curved chiefly towards the blunt end, gradually sharp-pointed, spined chiefly towards the base, less so afterwards, 90 by 4-6000ths inch in its greatest demensions (fig. 1, *c*); 2, short, acuate, curved chiefly towards the blunt end, which is somewhat inflated, gradually sharp-pointed, spined throughout, spines towards the pointed end recurved, longest spines round the blunt end, about 45 by 4-6000ths inch in its greatest dimensions (fig. 1, *e*); 3, subskeletal, acuate, smooth, slightly curved, fusiform, head smaller in its transverse diameter than the shaft, which terminates gradually in a sharp point, about 90 by $2\frac{1}{2}$-6000ths inch in its greatest dimensions (fig. 1, *d*); 4, flesh-spicule, equianchorate "angulate," very short and robust, shaft very much curved, arms thick, broad, and much expanded, about a quarter the length of the shaft, 7-6000ths inch long, shaft $1\frac{1}{2}$-6000th inch in diameter (fig. 1, *f*); 5, flesh-spicule, bihamate, simple, sigmoid, and C-shaped, 10-6000ths inch long (fig. 1, *g*). Nos. 1 to 3 are confined to the axis and body; no. 4, in great abundance, forms a thick crust which is supported on the points of no. 1, while no. 5 is comparatively scanty. Size of specimen about 3 inches long, largest stem about 1 inch in diameter at the base; pustuliform eminences about 1-12th inch in diameter at the base, and about half as high, but very variable.

Hab. Marine, 50–70 fathoms.

Loc. Sea between Patagonia and the Falkland Islands.

Obs. This sponge, dredged by Capt. W. H. Cawne Warren in the locality mentioned, is a species of *Halichondria*, allied, although considerably different in the form of its spicules, to *Halichondria incrustans*. It is chiefly characterized by the presence externally of the little pustuliform eminences mentioned, which may be assumed to be the localities respectively of the vents and the pore-areas, since there is nothing else on the surface to represent these parts. At first they look very much like the insulated parasitic polyps *Bergia*; but being conical, closed, and puckered towards the apex, instead of open, cup-like, and shallow, connected with a canal beneath

instead of being confined to the dermal structure, and possessing neither tentacles nor thread-cells, they are thus satisfactorily distinguished from polyps. We already have an instance of this pustuliferous character in *Greyella cyathophora*, which I described and illustrated several years ago ('Annals,' 1869, vol. iv. p. 190, pl. vii.), if not in Schmidt's *Cribrella hospitalis* also (Spongf. Atlantisch. Gebiet. S. 56, Taf. iv. fig. 12). The parasitic polyp *Bergia*, with which alone this pustuliform eminence can be confounded, is merely located on the surface of the sponge as a commensal, while the "pustuliform eminence" is a part of the sponge itself, connected with the interior by means of a pore-area or excretory canal, like the heads of *Cliona corallinoides* &c., whereon, as in many sponges, the radiated arrangement of the spicules permits of their being closed or opened as required; but in *Greyella cyathophora* the pore-areas *alone* are confined to the pustuliform eminences, while the oscules or vents are present under the common form. Besides this striking character in *Halichondria pustulosa*, the thick incrustation and the extremely robust, obese form of the equianchorate of which the latter is composed are equally specific.

Reniera digitata, Sdt.

This appears to grow in great abundance about the wharf at Antigua, and when fresh to present a "red" colour, which in the dried state it still slightly retains. The spiculations respectively in the mounted type specimens of *Reniera digitata* and *Myxilla anhelans*, Sdt., in the British Museum are the same. (See Pl. XI. fig. 3, *a–c*.)

Phorbas amaranthus, de F. et M. (p. 92, pl. xxi. fig. 1).

Cauliform, irregularly compressed, repent, straggling, budding into a branch here and there most irregularly, twisting back upon itself and uniting where in contact, adhering to any foreign objects it may touch during its course of growth, in short, doing every thing but growing regularly. Consistence firm. Colour dark-red purple. Surface over the points of the branches or younger parts cancellous or irregularly reticulated in relief, with the lines of the reticulation serrate or jagged, becoming more compact in the older parts, where the dermal sarcode conceals the points of the serrations, so as to leave nothing but a smooth surface of rounded processes with a number of holes, most of which appear to be connected with the branches of the excretory canal-systems, which in accordance with the mode of growth, are numerous. Internal structure fibro-cellular throughout, becoming less compact

towards the circumference; sarcode deeply coloured by an abundance of diffused pigment, presenting an amaranthine or red-purple hue. Spicule of one kind only, viz. acerate, small, thin, smooth, cylindrical or subfusiform, slightly curved, and sometimes indistinctly inflated at the ends, about 50 by $\frac{1}{2}$-6000th inch in its greatest dimensions (Pl. XI. fig. 15), chiefly confined to the fibre, which, with a minimum of kerasine, is composed of them, and in a looser way dispersed throughout the sarcode. Length of main stem in the largest specimen about 21 inches, breadth 1 by $\frac{3}{4}$ inch in diameter.

Hab. Marine. Adhering to any object with which it may come into contact.

Loc. Nassau.

Obs. Such are the characters of this species, which are so like those of de F. et M.'s *Phorbas amaranthus* that I have described it under their name. In colour and structure it is so much like *Halichondria birotulata*, Higgin, from the same neighbourhood, that nothing but a microscopic examination of the respective spiculations can reveal the differences; and notwithstanding the extreme likeness to it of the sponges which, in my Supplementary Manaar Report, I have named *Axos anchorata* and *A. fibulata*, especially in the extreme irregularity of their growth ('Annals, 1881, vol. vii. pp. 382, 383, pl. xviii. figs. 3 &c.), I now think the whole should be relegated to the group Halichondrina; for the light which a general examination of the good specimens of *Phorbas amaranthus* from the West Indies has thrown on that of the "imperfect specimens" from S. Australia, above mentioned, not only proves to me that the latter belong to the same group as *Phorbas amaranthus*, but that they should be withdrawn from the genus *Axos*, and their generic name changed to "*Phorbas*." As *Halichondria birotulata*, Higgin, which is found with *Phorbas amaranthus* in the West-Indian seas, is also largely developed on the south coast of Australia, it is not improbable that the latter exists there also in addition to *Axos*, now *Phorbas anchorata* and *P. fibulata*, already described from thence (*op. et loc. cit.*).

Group 8. Esperina.

Although the name "*Esperia*" originated with Nardo ('Isis,' 1833), it was Dr. Oscar Schmidt who first defined it satisfactorily, in 1862 (Spongf. Adriat. Meeres, S. 53), adding just previously the literature of the subject, to which I cannot do better than refer the reader for every thing else in this respect. Having already taken the appellation for the basis of my group "Esperina" ('Annals,' 1875, vol. xvi.

p. 179, &c.), I have only to repeat here what the occasion seems to require.

Character.—The group Esperina is mainly characterized by the presence of the *inequi*anchorate, which occurs in no other to my knowledge, except that of Hyndmanina, where not only the dark brown colour of the sponge itself, but the unique form of one of its flesh-spicules (the "contort bipocillated bihamate" of Dr. Bowerbank, Brit. Spong. vol. i. p. 248, fig. 125) is also, to my knowledge, met with nowhere else. The largest inequianchorate known was found by Schmidt in *Esperia diaphana,* from Florida, which measured "0·65 millim.," about equal to 1-40th inch long, while the smaller ones, although still large, only reached "0·12 millim." =1-222nd inch, which accords more with those in his mounted type specimen now in the British Museum, where the largest I could find only amounted to a little more than the last-named measurement (Spongf. Atlant. Gebiet. 1870, S. 57, Taf. iv. fig. 13). Other flesh-spicules occur in *Esperia,* viz. bihamate, tricurvate, and the sheaf-like bundles of fine spicules termed "trichites" by Prof. Sollas; but the presence or absence (perhaps influenced by their scarcity) of one or all of these seems to be as accidental as unintelligible; so their value in specific distinction is not much: *ex. gr.*, in my mounted fragment of the type specimen of *Esperia* (*Raphiodesma*, Bk., 1870) *florea*, there is a tricurvate which no doubt belongs to the species; and in one of *Esperia* (*Rhaphiodesma*, Bk.) *lingua* there are sheaf-like bundles of trichites, neither of which are mentioned in the descriptions or illustrations of these sponges respectively by Dr. Bowerbank (Brit. Spong. vol. ii. of 1865, illustrated in vol. iii. of 1874).

Again, the skeletal spicule, although always acuate, is not simply so; for very often it is sub-pinlike and presents a peculiar elongated elliptical inflation, sometimes widened in the centre like a skittle or barrel; it is also always single—that is, unaccompanied by any other skeletal form; while the inflation may vary so as to pass from the simple uninflated acuate into the shapes mentioned, even in the same specimen; hence, if the illustration should be taken from the former it will be acuate, and, if from the latter, sub-pinlike. Thus, in Dr. Bowerbank's illustration of *Esperia* (*Rhaphiodesma*) *lingua*, the form is a simple acuate (Brit. Spong. vol. iii. pl. lxxvii. fig. 2), while in my mounted fragment of the type specimen in the British Museum it is sub-pinlike or elliptically inflated with a central swelling. Variable, however, as the shape of the obtuse end of the skeletal spicule may be, an average one may be obtained by extended observation, while the form

generally of the skeletal spicule is so far peculiar in itself that a practised eye can almost always recognize its Esperian character.

Size.—In measuring these spicules, again, great care should be taken; for here as well as elsewhere it should never be forgotten that things must be small before they are great; hence both skeletal and flesh-spicules of all sizes below the average largest may be present in the specimen; hence the necessity of finding out the *average*: thus, the so-called "tension-spicula," viz. figs. 16 and 3 in Dr. Bowerbank's illustrations of *Esperia* (*Rhaphiodesma*) *florea* and *lingua* respectively, appear to be only *small* forms of the skeletal spicules (figs. 15 and 2), which, as the dermal layer becomes part of the internal structure in the course of growth, become enlarged to the size of skeletal ones.

Rosettes.—The well-known "rosettes" which characterize the spiculation of *Esperia*, viz. the globular development of a multitude of *in*equianchorates (instead of a single one in a cell, as with the bihamates and tricurvates, &c.), which radiate from a common centre with their small ends inwards, is not always confined to the *in*equianchorate flesh-spicules; for the same kind of development may occur in *Desmacidon titubans*, Sdt., where the anchorates are equally developed at each end, as seen in Schmidt's mounted type specimen of this sponge in the British Museum (Pl. XII. fig. 24, *g*, *h*). No one, however, has described and illustrated the development of the "rosette"—that is, the *in*equianchorate in plurality in its cell; although singly it has been done by Schmidt and myself independently (Nord-See Exped. 1872, "Zoologie," Taf. i.; and 'Annals,' 1874, vol. xiv. p. 100, pl. x.).

Lastly, there is a characteristic dermal structure in *Esperia* which for uniformity and beauty of its stellification equals, if not surpasses, any other of the kind. This consists of a stelliferous lacework formed by intercrossing bundles of the skeletal spicules (whose interstices when fresh are tympanized by the dermal sarcode in which the pores are situated), supported by a more or less rigid spiculo-fibrous structure internally, that, especially when rigid, is equally characteristic of *Esperia*. Sometimes, however, the "lacework" structure of the surface seems, from some cause or other, to become a broken-down or confused layer of spicules, in which state the two conditions may be seen to pass into each other in the same specimens; or the dermal layer together with the softer structure filling the interstices of the rigid skeletal fibre may be washed away altogether, while the latter remains in a naked condition (see Schmidt's representation of *Esperia Contarenii*,

Spongf. Adrit. Meeres, Taf. v. fig. 2; and my own of *Esperia villosa*, 'Annals,' 1874, vol. xiv. pl. xiii. fig. 13, *a*); after which the soft structure may again spread partially or wholly over it, so that the specimens often present themselves with much of the skeletal fibre still, so to speak, unclothed. This, however, is only where the fibre-skeleton is very rigid, which is not the case in all instances, as in *Esperia* (*Rhaphiodesma*) *lingua*, and also in the West-Indian species about to be described, in which the difference in the structure is not so much marked. Indeed the type specimen of the former, viz. *Rhaphiodesma lingua*, Bk., seems to have been squeezed up together into its present "tongue-shape" by the hand, which does not seem improbable, seeing that the type specimen which Mr. Peach sent to Dr. Bowerbank from Shetland "was cut to pieces in the dredge and rotted in drying" (Brit. Spong. vol. ii. p. 190). Sometimes the lacework of the dermal layer of *Halichondria panicea* is so much like that of *Esperia* that, without microscopic examination of the spicules, the difference cannot be determined. We shall also find by-and-by that there is a still greater resemblance in this respect between *Esperia* and *Hymedesmia Johnsoni* of the following group. In the meanwhile I will describe the West-Indian specimen.

Esperia lævis, n. sp.

Massive, sessile, lobate. Consistence light, soft. Texture tomentose. Colour light brown, in some parts reddish. Surface irregularly lobate, uniformly covered by the dermal layer above mentioned, but with the stelliform arrangement of the spiculation for the most part reduced to an amorphous condition. Vents on the summits of the lobes. Internal structure more fibrous, but with the spiculation almost as much confused as in the dermal one. Spicules of five forms, viz.:— 1, skeletal, for the most part acuate, slightly curved, smooth, shaft fusiform, broader in the centre than the obtuse end, abruptly sharp-pointed, about 115 by 3-6000ths inch in its greatest dimensions (Pl. XI. fig. 16, *a*); 2, flesh-spicule, inequianchorate, about 18-6000ths inch long, head and naked part of shaft about equal in length, smaller and about one third of the whole, arms at their ends respectively equal in length (fig. 16, *b*); 3, flesh-spicule, bihamate, smooth, C-shaped, more or less sigmoid, about 10-6000ths inch long (fig. 16, *c*); 4, flesh-spicule, trichites, separate, and in sheaf-like bundles, about 16-6000ths long (fig. 16, *d*); 5, *minute* inequianchorate, in which the arms of the head nearly extend down to the lower or smaller end, and the latter presents an elongation of the shaft (?) into a pointed process about 5-6000ths long (fig. 16,

e, f). No. 1 is chiefly confined to the fibre, and the rest, of various sizes, more or less abundantly scattered throughout the softer substance, but especially abundant in the dermal layer, where the inequianchorates are present in the form of rosettes. Size of largest piece, of which there are several, about $5 \times 2\frac{1}{2} \times 1$ inch.

Hab. Marine. Growing over all kinds of objects in its course, which seems to have been vagrant about the sea-bottom, as some of the pieces, besides enclosing shells, present the waterworn appearance of having been subjected to attrition in shallow water, which may account for the pulpy amorphous condition of the dermal layer.

Loc. Puerto Cabello.

Obs. This sponge in structure and spiculation is very like *Esperia lingua*; only the smaller end of the large inequianchorate is proportionally longer in the latter, and not so round when viewed in front. Like *E. lingua*, too, the confusedness of the general structure in both species seems to have been broken down through some cause or other. With the exception of the pointed process at the small end of the *minute* anchorate, there is very little else to make it differ from *E. lingua*, whose representative it may be in the West Indies. Out of all my mountings (and I have several of different kinds of *Esperia* from different parts of the world), there is only one in which this character is present; and that is a small specimen in the late Dr. Bowerbank's collection, now in the British Museum, labelled "Comoro Is., Mozambique," wherein every other part so agrees with the West-Indian one that, without the labelling, I should have adjudged it to this locality; but, in Schmidt's report of the German expedition to the North Sea in 1871, there is a figure of this kind of process in a minute inequianchorate about "0·03 millim." (Taf. i. fig. 7)—that is, about 3-6000ths or 1-2000th inch in "*Esperia anceps*," = *Desmacidon anceps* (*l. c.*), which he considered a "variety." It is, however, *characteristic* of the inequianchorate in the Hyndmanina (see the illustrations of *Halichondria Pattersoni*, Bk., Brit. Spong. vol. iii. pl. xlvi. fig. 5, and Ridley, Proc. Zool. Soc. 1881, in *Alebion proximum*, p. 119, pl. x. fig. 8, *b*), where the latter is 6-6000ths inch long, or twice the size of Schmidt's and my own specimens.

Further Observations on the Esperina.

Having thus given a description of the specimen of *Esperia* obtained when the 'Argo' was at Puerto Cabello, I will now continue my observations on the group. Commencing with

Schmidt's numerous species (and we need not go further back, as it would only lead us into the region of doubt, which has been well summed up by Schmidt himself, as before stated), there are twelve species from the Adriatic, of which ten are in his publication of 1862, and the two others, with figures of the inequianchorate only of an "Indian species," in the 1st Supplement; three in the Atlantic sponges of 1870; three in the report of the expedition to the North Sea (Deutschen Meere) of 1871; two in that of the expedition of 1872 (Nord-See Expedition); and one in that of the summer expedition to the Baltic (Ost-See) in 1871 (Berlin, 1873, S. 148), viz. *Esperia lucifera.* Of these the figures of the anchorates of the "Indian species" and two of the Atlantic ones, viz. *E. diaphana* and *E. immitis* respectively, are the only ones which seem to me to possess an amount of difference in their inequianchorates respectively which renders them of any specific value; while all the rest are so much alike that the anchorate alone is of no utility for this purpose. My observations are taken rather from Schmidt's type specimens on the slides in the British Museum than from his published descriptions and illustrations, in which I find that *E. immitis* is my *E. socialis* of 1871, also from the West Indies ('Annals,' vol. vii. p. 276, pl. xviii. fig. 7, &c.).

Of the British species of *Esperia* represented by Dr. Bowerbank, viz. *Hymeniacidon subclavata* (B. S. vol. iii. pl. xxxvii. figs. 9–13) and *Rhaphiodesma floreum* (ibid. figs. 14–19), both on valves of a *Pecten*, the inequianchorates appear to be alike, although the skeletal spicules are so far different in the illustrations that the former is simply acuate, *i. e.* without terminal inflation, and the latter sub-pinlike; but this difference, as I have said before, is not of much specific value, as it is not more persistent than the absence or presence of the tricurvate, which also, as before mentioned, exists in *my* mounting of the latter. As for the anchorate of *H. subclavata* being "bidentate," this I regard as an ocular delusion, having *never* found less than *three* teeth or arms if carefully looked for, a fact which will be better understood by reference to my descriptive and illustrated anatomy of the inequianchorate ('Annals,' 1871, vol. vii. p. 277, pl. xvii. figs. 7, 8, &c.). Thus, if the anchorate be viewed *laterally*, only two arms will appear, viz. the anterior and the nearest lateral, giving a bidentate aspect, while if it be viewed in front all three will appear; but neither is so convincing as an end view, which can only be obtained when the anchorate is tilted upwards; and then the two lateral arms, one on each side the shaft, with the anterior arm in the middle supported on the "falcate" septum, become convincingly obvious.

The spiculation of *Hymeniacidon macilenta*, Bk. (which is also an *Esperia*), obtained from the most insignificant "fragments" in point of size, of which "the largest piece only slightly exceeded an inch in length, and was about three lines in width" (B. S. vol. ii. p. 176), such as I have often found here (Budleigh Salterton) about the roots of *Laminaria digitata*, seems to me but a variety of *Esperia* (*Rhaphiodesma*) *florea*, in which all three of the flesh-spicules are present, viz. inequianchorate, bihamate, and tricurvate (B. S. vol. iii. pl. xxxiii. figs. 7–13). "*Rhaphiodesma*" (Dr. Bowerbank's *last* generic name for Esperian sponges) *simplissimum* (B. S. vol. iii. pl. xc. figs. 1–3) is evidently from the spiculation no *Esperia* at all, while *Desmacidon rotalis* in the same plate (figs. 8–14) undoubtedly is one, and the great length of the head of the anchorate relatively considered (that is, in proportion to the size of the other parts) a characteristic feature, especially as the figure is that of a *full-grown* anchorate magnified upon the same scale as that of *R. floreum*, Bk., viz. "× 530 linear," and not a minute incipient form. Here again the skeletal spicule is simply acuate; and the structure represented in fig. 9 is evidently that of the lace-like dermal layer characteristic of an *Esperia*, to which I have alluded. In *R. sordidum* (pl. lxxvi. figs. 13–19) we seem to have an insignificant specimen, which is only a slight variety in spiculation of *R. floreum*, wherein the tricurvate has been more strongly developed, while *R. lingua* (pl. lxxvii.), in the comparatively greater length of the arms of the smaller end of the inequianchorate (fig. 4), *does* present a characteristic form, although the head of the skeleton-spicule (fig. 2) should instead of acuate be sub-pinlike, *i. e.* elliptic, inflated in the centre, skittle-shaped; for the *average* is so in the *type specimen*, which, as a whole, appears, as before stated, to derive its general tongue-shaped form from having been squeezed up in the hand after it was drawn on board in a comminuted state. Still, such is the rigidity of the fibro-skeletal structure in many instances, that if there had been any present some would have remained to testify to the fact; hence we may infer that the structure was always soft, as it now is, like that of the West-Indian specimen above described. Reviewing thus all that has been put forward by Dr. Bowerbank, together with my own actual experience, I see no indication, from the *spiculation*, of there being in his 'Monograph of the British Spongiadæ' any more than two well-characterized species of *Esperia*, viz. *Rhaphiodesma floreum* and *R. lingua*.

But that there are more British species of *Esperia*, my examination of the sponges dredged on board H.M.S. 'Por-

cupine' between the north of Scotland and the Färöe Islands will show ('Annals,' 1874 and 1876, vols. xiv. and xviii. pp. 215 and 316 respectively). In *Esperia cupressiformis* (vol. xiv. pl. xiv. figs. 16–19) the general form and spiculation will be found to be very remarkable; while in the variety *bihamitifera* (vol. xviii. pl. xiii. fig. 14) it is hardly less so. The species *E. borassus* (ibid. fig. 13) has hardly any thing to characterize it beyond the peculiar arrangement of its spicules, which have nothing remarkable in their forms beyond the common run. In *E. placoides*, however, we have all the common characteristics in spiculation, together with the rigid fibro-structure internally and the lace-like dermal layer in the grooves or "pore-areas" (fig. 12, *k*, *l*) between the placoid plates, while the latter in their structure give the species this striking peculiarity. But when we turn back to *E. villosa* (vol. xiv. pl. xiii. figs. 13–15), there we find an *equi*anchorate instead of the usual Esperian form (that is, with unequal ends), which makes one doubt the appropriateness of the generic term, as will be more particularly shown by the following observations, viz.:—

While engaged in looking over my slides of different *Esperiæ* for the present occasion, I recurred to that bearing the spiculation of the "Unknown Sponge," published in the 'Journal of the Royal Microscopical Society (1879, vol. ii. pl. xvii *a*, fig. 12), which, it may be remembered, was found in the form of a mere film on the foraminiferal test of *Aphrosina informis*, Carter, that, again, was on the branched coral *Amphihelia oculata*, Duncan, which had been dredged on board H.M.S. 'Porcupine' in the Atlantic Ocean, between the north of Scotland and the Färöe Islands, and I immediately saw that there existed a great resemblance—indeed, almost an identity, between it and the spiculation of *Esperia villosa*. It may be remembered also that, in both these instances, the bihamate was strikingly large—that is, in the former 82½-6000ths and in the latter 40-6000ths inch long, a coincidence of large sizes in these flesh-spicules which first attracted my attention to the respective slides, as in no other case has the bihamate been found so large. I have already stated that the anchorate was *equi*ended in *Esperia villosa*; and I might here add that it is of that shape which I have termed navicular or weaver's shuttle-like, thus totally opposed to the usual form in *Esperia*, viz. *in*equianchorate, but precisely like that of the "*Unknown Sponge*." In the latter, being a mere film, there is nothing but the spiculation to judge from; but in *Esperia villosa*, which is comparatively large, the surface is totally different from that usually characteristic of *Esperia*, as may be seen

from my description and delineation (*op. et loc. cit.*), while the only things that are like *Esperia* are the skeleton-spicule in both the "*Unknown Sponge*" and *E. villosa*, and the rigid skeleton-fibre in the latter. Under these circumstances I propose to change the name of "*Esperia villosa*" to that of "*Esperiopsis villosa*," and for the present to place it in the following group, viz. Hymedesmina.

But lest it should be asked, "Why add it to Hymedesmina in particular?" it may be observed that the nearest known structures to *Esperia* have been placed in the Hymedesmina.

Thus, in one of the massive specimens of *Hymedesmia Johnsoni*, Bk., dredged on board H.M.S. 'Porcupine' between the north of Scotland and the Färöe Islands, which had grown upon a little stone, and which, being subcylindrical, is an inch long by half an inch in diameter, the same kind of stellificate lace-like dermal structure and the same kind of rigid spiculo-fibrous skeleton exists as in a similarly-constituted *Esperia*. Moreover, another but membraniform specimen that had grown over the surface of a *Stelletta* which had itself grown on the branch of a stony coral obtained from the sea about the island of Madeira (British Museum, no. 360 and 361, presented by the Rev. R. F. Lowe), is so like the dermal layer of *Esperia* that at first I took it for one, until convinced to the contrary by microscopical examination, when I found the skeletal spicule also to be almost identical in form with that of *Esperia*, accompanied, too, by a large tricurvate (Pl. XI. fig. 20, *a*, *b*); so that, but for the presence of that extraordinary form of flesh-spicule (fig. 20, *c*, *d*, *e*), to which I shall allude more particularly hereafter, these specimens might be taken for those of an *Esperia*. Hence, with the Esperian structure of the fibro-skeleton of *Esperia villosa*, now *Esperiopsis*, and its Esperian skeletal spicule, together with the extraordinary sizes of its flesh-spicules respectively (extraordinary for a *naviculiform* anchorate), its massive as well as membranous forms are better placed with the Hymedesmina than with the Esperina, where their anchorates, being equi-ended, would at once break down the main characteristic of our group.

It might be observed, too, that the forms *Esperiopsis villosa* and *Hymedesmia Johnsoni* respectively were brought up in the dredge together, or, at all events, at the same station, viz. "51 of 1869;" for they were in the same jar that bore this label.

This opportunity also might be taken of stating what is known of *Hymedesmia Johnsoni*, Bk., 1864, = *Desmacidon Johnsoni*, Sdt., 1870, as it has not been found to have grown

much beyond a membranous form on most occasions. In the first place, two species or one and a variety of it, occur, viz. *Hymedesmia Johnsoni*, which, in addition to the double-hooked "trenchant" flesh-spicule, common to both (Pl. XI. fig. 20, *c*, *d*, *e*), has a single form of *acuate* skeleton-spicule, viz. Esperian (Pl. XI. fig. 20) and a tricurvate flesh-spicule strongly developed (fig. 20, *b*); the *acuate* spicule clearly, from Dr. Bowerbank's illustration of a membranous growth from Madeira (B. S. vol. i. p. 35, pl. xviii. fig. 293), indicates that *it* is *Hymedesmia Johnsoni*, Bk., and has been found between the north of Scotland and the Färöe Islands, as above stated, also on a *Stelletta* coming from Madeira in a membranous form by myself; to which we may add the coast of Portugal probably (Schmidt, Spongf. Atlantisch. Gebiet. p. 54); as well as that from Shetland figured by Dr. Bowerbank in 1874 (B. S. vol. iii. p. 208, pl. lxxiv. figs. 1–3) under the name of *Halichondria falcula*, which is probably the largest massive specimen (being about 2 inches long and 1 inch broad) that has yet been obtained. Although the tricurvate spicule is only mentioned in the specimens from the north of Scotland and Madeira, the *acuate* spicule is sufficient for identification in the others.

Schmidt's form, on the other hand, was obtained from the coast of Florida, and from its possessing in addition to the trenchant anchorate an *acerate* skeleton-spicule, accompanied by a *bihamate* flesh-spicule *only* (Pl. XI. fig. 21, *a*, *b*), might be termed *Hymedesmia Schmidtii*. His specimen was membraniform (Spong. Atlant. Gebiet. p. 53); and this form and spiculation also occur among the dredgings of H.M.S. 'Porcupine,' as evidenced by a small fragment of a massive specimen obtained at the entrance of the English Channel in 725 fms. at Station 36; so that there are evidently two different spiculations of this sponge characterized by the same peculiar anchorate, however much alike the general forms may be.

At the conclusion of his article on *Desmacidon Johnsoni*=*Hymedesmia*, Bk., Schmidt states that the "trenchant" spicule (Bowerbank's term, because the inner edge of it is thinned off like a knife) with hook at each end is allied to a bihamate; but in *Hymedesmia Schmidtii* the other flesh-spicule which is so abundantly present is a *veritable* C-shaped and sigmoid *bihamate*, whose contrast in form with the early development of the great trenchant spicule when both are about the same size is most evident (Pl. XI. fig. 21, *a*, *b*, *c*). The reversed position of the hooks, viz. one turning right and the other left ("rechts und links"), like the ends of a bihamate, seems to have influenced him in this decision (figs. 20 & 21, *c*). But

setting aside for a moment the fact that in *Hymedesmia Schmidtii* the trenchant spicule is accompanied by genuine simple C-shaped bihamates, we find in the other sponge which I have placed in this group, viz. *Desmacidon titubans*, Sdt., that the central arm at both ends of the undoubted anchorate is similarly reversed and accompanied by an abundance of C-shaped bihamates, although of unusual size (Pl. XII. fig. 24, *c–h*). Comparing this anchorate, then, to the trenchant spicule of *H. Schmidtii* as well as to that of *H. Johnsoni*, which is the same, we must infer, I think, that this spicule represents an anchorate as I have called it, and not a fibula or bihamate.

Lastly, it has been generally supposed that no equianchorates are ever found in the "rosette"-form presented by the *in*equianchorates in *Esperia*; but in Schmidt's type specimen of *Desmacidon titubans*, in a slide at the British Museum, may be seen "rosettes" of the *equi*anchorate peculiar to this species and similar to those of *Esperia* (Pl. XII. fig. 24, *h*).

Returning now to the group Esperina, I have observed that in some species of *Esperia* there is a very minute *equi*anchorate of the navicular shape in great abundance and not more than $2\frac{1}{2}$-6000ths inch long (Pl. XI. fig. 19, *a*, *b*). This was first noticed in specimens belonging to the British Museum, viz. in nos. 123 and 286, both of which, unfortunately, are without locality, while the other figures on them are "28 *a*" and "68. 11. 26. 24" respectively; and just now I have found it in the mounting of a specimen from this beach (Budleigh Salterton) otherwise possessing a spiculation like *Esperia fiorea*, Bk., but with the skeleton-spicule a simple acuate, *i. e.* without any inflation of the blunt end. It is also present in a specimen from the Mauritius (*E. plumosa*, mihi), to be hereafter mentioned. Schmidt also noticed this kind of minute equianchorate as a "variety," in the spiculation of his *Esperia anceps*, figured in his report of the sponges found by the 'Germania' in her expedition of 1871 to the North Sea (Taf. i. fig. 8), of which the measurement is given under its other name, viz. *Desmacidon anceps* (p. 432) as "0·03 millim.," which is much the same as that above stated, hence very minute. It certainly is more minute than the minutest *inequianchorates* visible in the same slides; and therefore the *in*equianchorate may possibly *begin* its development in this form. However, it does not appear in the ovular embryo of *Esperia*, while the *in*equianchorates do, as my representation will show ('Annals,' 1874, vol. xiv. pl. xxi. fig. 25). The specimen of *Esperia* from the Mauritius in which this minute equianchorate occurs was picked up by Col. Pike some years

ago when U.S. Consul there, and finally came to me through Dr. Dickie for examination. From its present feathery form, its spiculation may be briefly described under the name

Esperia plumosa, n. sp.

Skeletal spicule sub-pinlike, with the head much smaller than the thickest part of the shaft, 80 by $2\frac{1}{2}$-6000ths inch in its greatest dimensions; inequianchorate 12 by 5-6000ths inch; a simple C-shaped bihamate 21 by $1\frac{1}{2}$-6000ths, and a tricurvate 20-6000ths inch long; all of the ordinary forms; together with the minute *equi*anchorate $2\frac{1}{2}$-6000ths long, in great abundance, but perhaps not more so than the minute bihamates and tricurvates; while the smallest *in*equianchorates are about 4-6000ths inch long.

Esperia obscura, n. sp.

Is a fragment of a massive specimen about $2 \times 2 \times 1$ inch in its greatest dimensions, with all the characters of *Esperia*, viz. lace-like dermal layer, rigid interior fibre, and acuate (sub-pinlike) form of skeletal spicule, but with an inequianchorate about 5-6000ths long so transparent in its detail that all I can give of it are the representations (Pl. XI. fig. 18), in the hope that it might be thus recognized and finally illustrated anatomically.

Loc. Fremantle. Found in a *rotten* state in Dr. Bowerbank's collection.

RHAPHIDOTHECA, Kent.

In the specimens of *Rhaphidotheca Marshall-Halli*, Kent, and *R. affinis*, Carter, both of which are *Esperiæ*, the anchorates differ so little that, unless the accurately delineated forms respectively are placed side by side as I have done (Journ. Roy. Microscop. Soc. 1879, vol. ii. pl. xvii. *a*, figs. 3 and 4), the differences are almost too slight to be of any specific value; and, after all, they may be only varieties; while the presence of the *pin like* spicules in each, with their heads outermost, accompanied by their *spirular* flesh-spicules, has been shown to be adventitious (ibid. pp. 497, 498) or appropriated, having first belonged to another sponge. It is remarkable also that the specimens should come from parts wide apart, viz. *Rhaphidotheca Marshall-Halli* from the Atlantic on the coast of Portugal, and *R. affinis* from the Atlantic between the north of Scotland and the Färöe Islands, both upon closely allied forms of branched stony corals, in one of which my *Cliona abyssorum* with the same kind of smooth spirular flesh-spicule occurs.

Peculiarity in the Anchorate.

The only undescribed species of *Esperia* that I have examined, in which the inequianchorate possesses a decided peculiarity, is the following, viz.

Esperia Cunninghami, n. sp.

Massive, lobate, sessile. Colour now pale yellow. Surface undulating, rugose; dermal layer lace-like, formed of a stout reticulated structure, composed of smooth spiculo-fibre, underneath the interstices of which is a finer one of the same kind, whose interstices in the fresh state are tympanized by the dermal sarcode in which the pores are situated; supported internally by a rigid spiculo-fibrous skeleton, whose branches become thicker towards the older and first-formed parts of the structure, which is traversed by the branches of the excretory canal-system that open here and there in large vents on the surface. Spicules of five forms, viz.:—1, skeletal, acuate, almost cylindrical, smooth, curved, abruptly sharp-pointed, slightly constricted inside the head, or with the latter elliptically inflated, about 112 by 2-6000ths inch in its greatest dimensions (Pl. XI. fig. 17, *a*, *b*); 2, flesh-spicule, inequianchorate, 10–20-6000ths inch long, head oblong, narrow, a little longer than the rest of the body, anterior or petaloid arm a little shorter than the lateral ones, which are somewhat everted at the free end; anterior arm of the *smaller or lower end* prolonged upwards into a pointed conical process (fig. 17, *c*, *g*); 3, flesh-spicule, bihamate, very fine, back or shaft straight, suddenly curved in opposite directions at the ends, about 6-6000ths inch long (fig. 17, *d*, *h*); 4, flesh-spicule, simple, tricurvate, very small, bow-shaped, 10-6000ths inch long (fig. 17, *e*); 5, trichites in sheaf-shape bundles about the same length (fig. 17, *f*). No. 1 is chiefly confined to the dermal and skeletal structure; 2 is sparsely present, chiefly in the dermal layer, together with 3 and 4, which are extremely fine and scanty. Size of one of the largest of the pieces, of which there are many, all belonging apparently to the same specimen, which must therefore have been very large, 6 by 4 inches in its greatest diameter.

Hab. Marine.

Loc. Stanley Harbour, Falkland Islands, and Otter Island, Patagonia.

Obs. The "process" which is extended upwards from the central or petaloid arm of the lower end of the inequianchorate, and is a simple elongation of this tongue-like part (fig. 17, *g*), is the most distinguishing and striking character in this

species. Probably the larger size mentioned is the fully-developed form, although by no means the most plentiful. The bihamate is also peculiar, and so difficult to find from its fineness and scarcity that I do not place much dependence on the form and size given of it; hence consider that what I have stated requires confirmation. Possibly in some parts of the specimens which have not come under my observation the flesh-spicules may be larger, more marked, and more plentiful; but after a prolonged search I have not been able to find them. The skeletal spicule, as in most other species, varies in the form of the head, being in one part simply acuate and in another more or less inflated (fig. 17, *a*, *b*). The specimens, according to the label, were obtained by Dr. Cunningham, after whom the species is named, and found at the places mentioned. They are all in the British Museum, and, besides my running no. 441, bear the register nos. 68. 6. 29. 22 and 72. 4. 19. 3 respectively. Mr. Stuart Ridley has alluded to them (Proc. Zool. Soc. 1881, p. 117, pl. x. fig. 5) for comparison with his *Esperia magellanica*, the spiculation of which is of the common type.

Although *Esperia Cunninghami* is the only species in which I have found the "inequianchorate" to present the peculiar character above mentioned, there is another in which the *bihamate* equally possesses one; and that is the *serrated* form in *Esperia serratohamata*, found among the Gulf-of-Manaar specimens from Ceylon ('Annals,' 1880, vol. vi. p. 49, pl. v. fig. 20, *b*).

[To be continued.]

XXX.—*Report on the Nematodes in the Possession of the British Museum, with a Review of the Classification of the Order.* By Dr. L. Örley.

[Plate X.]

Since the year 1853, in which Baird's 'Catalogue of the Species of Entozoa contained in the Collection of the British Museum' appeared, the collection has been enriched by the addition of some interesting forms, the enumeration of which will afford matter of interest to those acquainted with the group. Our knowledge of the Nematodes has undergone such changes during the last thirty years, that a fresh survey of the collection was certainly desirable. Many species reputed

to be distinct are young forms of other species; and the systematic arrangement has much altered with the increase of our knowledge. To take one example:—*Ascaris incisa*, Rud., has been recognized as the young form of *Ascaris depressa*, Rud.; a large number of the species of *Ascaris* have been removed to other genera; and all the forms assigned to the genus *Agamonema*, Dies., have been discovered to be immature Ascarids. For this reason, indeed, I have put asexual forms aside, and have described, without giving specific names, those which seemed of special interest.

Although the collection of Nematodes cannot be set down as a very rich one; yet it derives value from the circumstance that a tolerably large number of genera are represented, and that it contains the original specimens of the species described by Baird and Siebold. The specimens are unfortunately, as in most other collections, not in the best state of preservation; so that a renewal of many species is very desirable. The greatest attention has, indeed, been devoted to the collection recently; but it is impossible to restore those specimens in which decomposition has already set in. Some little experience in the matter has taught me that if the worms are washed in 10-per-cent. nitric-acid solution and killed in weak alcohol, they will keep remarkably well, if they are gradually transferred to stronger spirit, and if strong spirit be added to the old alcohol every six months.

I must content myself on this occasion with simply enumerating the species in the collection, without going into the literature after the manner and with the same fulness as in Baird's Catalogue; for Linstow's Compendium * contains almost the entire bibliography, and I could at best only copy this. However, I shall take the liberty of enumerating certain species which are accidentally omitted from Linstow's Catalogue and of correcting certain errors, in order to supplement this useful book where possible †.

By the kindness of Dr. A. Günther, the Keeper of the

* A very complete account of the literature of Entozoa is to be found in Dr. Cobbold's excellent work 'Entozoa,' &c., 1879.

† 1. *Ascaris lævissima*, Baird, 'Catalogue of the Species of Entozoa,' London, 1853, p. 25. *Hab.* India.

2. *Ascaris bifaria*, Baird, ibidem, p. 26. From the Korea.

3. *Ascaris unduloso-striata*, Baird, is introduced as *noduloso-striata*, and the host *Sarcorhamphus* is set down in the alphabetical list as *Sacorrhamphus*.

4. *Filaria gracilis*, Rud. Synops. Entoz. p. 208; Dujardin, Hist. nat. d. Helm. p. 46; Schneider, Monogr. d. Nemat. p. 87. *Hab.* In the peritoneum of *Lagothrix Humboldtii* and *Cebus capucinus*.

5. *Filaria sanguinea*, Rud. Synops. pp. 5 & 211; Dujardin, Hist. d. Helm. p. 61.

Zoological Department, I received permission to examine the collection, and was assisted in every way by Prof. Jeffrey Bell; I then exerted myself to arrange it according to the most recent system. I confess I found difficulty in deciding on which system to proceed; for, as is well known, various opinions prevail on the subject. Laying aside the old classifications of Rudolphi and Diesing, there remain the views of Bastian, Dujardin, and Schneider, and, further, those important discoveries which have been made by Leuckart and Claus on the Rhabditidæ and by Bütschli and de Man on free-living forms. I must say, at the same time, that our knowledge is, relatively, so poor with regard to the two latter groups that a monograph especially of the Rhabditidæ is much to be desired. Our acquaintance also with the general development of the Nematodes is very limited, so that we have no characters except those of the anatomy and biology by which to direct our systematic arrangement of the group.

The first question to be solved is whether the free-living should be placed with the parasitic forms, or whether the two should form independent groups.

In answer to this, different investigators have put forward different opinions. Dujardin* and Schneider† placed the free-living and parasitic forms together, while Bastian‡ considers them to be independent of each other. The two first named had but little acquaintance with the free-living forms, while the latter investigated both groups profoundly, leaving however, unfortunately, the Rhabditidæ out of consideration.

In the system of Dujardin we find all free-living forms united under the name "Enopliens," with two parasitic genera *Passalurus* and *Atractis*, a proof that they had some characters in common. When our knowledge became so immensely increased by the investigations of Bastian we came into the possession of characters which admitted of the separation of the two parasitic genera. Schneider endeavours to classify both groups by the muscular system; but Bütschli§ and other workers have sufficiently proved that by it the most closely related forms are separated.

Since Leuckart‖ and Claus¶ carried out their studies on

* Hist. nat. d. Helm. (Paris, 1845).

† Monographie der Nematoden (Berlin, 1866).

‡ "Monograph of the Anguillulidæ," Transactions of the Linnean Society of London, vol. xxv. 1865.

§ Beitrage zur Kenntniss der freilebenden Nematoden (Dresden, 1873).

‖ Menschliche Parasiten, 1863 and 1876.

¶ Beobachtungen über die Organisation und Fortpflanzung von *Leptodera appendiculata* (Marburg, 1869).

Rhabditidæ and Rhabditoid larvæ we have become acquainted with transitional forms which appear to connect the free-living and parasitic groups. The chief of these are *Rhabditis nigrovenosa* and *appendiculata*, which show a close connexion with the parasitic genus *Oxyuris*, both from a biological and an anatomical point of view. So thoroughly does Bütschli* recognize this relationship that he considers it desirable to unite the genera *Oxyuris*, *Cephalobus*, *Anguillula*, and *Rhabditis* into one genus. I have proposed † the name Rhabditiformæ for the group. Our task, then, is to discover whether this group can be maintained in its independence, and whether the parasitic and free-living forms are to be separated, or whether a continuous chain of modifications connects all Nematodes, admitting of no lines of demarcation. We have thus come to the point at which Bastian commenced fifteen years ago; and it is to be regretted that the characters which he put forward as distinguishing the two groups from one another have not been remembered as well as they deserved.

I shall show, in the first place, that characters exist by which the so-called Rhabditiformæ may be separated from the real free-living species or Anguillulidæ.

De Man ‡ was the first to demonstrate that our terrestrial and freshwater forms have been developed from three or more marine original forms; and I have assigned to that which gave rise to the Rhabditiformæ the name of "*Protoncholaimus*." From this the species of *Mononchus* and *Diplogaster* are developed. *Diplogaster* is even provided with a doubly-bulbed œsophagus, a sign that it inclines to a parasitic life; but the organs usually coincident with a free existence, such as the circumoral bristles and the lateral circular markings, are not wanting. From *Diplogaster* sprang other forms in two directions; one division has kept the bristles and lateral circular markings and acquired a caudal sucker as well (*Plectus*, Bst.), while others have entirely lost these organs, necessary to a free life; this may be taken as a sign that they have passed into a parasitic state of existence. It is just these latter species which represent the group of the Rhabditiformæ. All other free-living species known at present have at least one of the organs I have named; and many have eyes besides. Points of difference occur in the mode of reproduction and manner of life.

* "Ueber freilebende Nematoden," Zeitschr. f. wiss. Zool. Bd. xxvi.

† Monographie der Anguilluliden: Budapest, 1880. (Editio separata e "Természetrajzi füzetek," vol. iv. partes i., ii. 1880. A musæo nationali hungarico edita.)

‡ 'Onderzoekingen over vrij in de Aarde levende Nematoden,' Leide, 1875.

The difference, on the other hand, between the free-living and truly parasitic forms is much greater; for we find distinctive characters both in the structure of the cuticle, and in that of the reproductive organs and nervous system. The cuticle of the free-living forms is tolerably thin in comparison with that of the parasites; the genital tube is simple and devoid of convolutions in the former, while in the latter the structure is complicated and there are many convolutions. In the parasitic forms the nervous system is represented exclusively by an œsophageal ring made up of nerve-fibres and nerve-cells, while in the free-living forms it is either entirely absent or consists only of a few fibres. A study of the cellular mass belonging to the nervous system (?) which surrounds the œsophagus in the free-living group discloses another important difference. On the other hand, the Rhabditiformæ stand near the free-living forms in these latter points, and are separated from the parasitic forms by the same characters; though, at the same time, the parasitic stage of *Rhabditis nigrovenosa* approaches the parasites in many points. *Oxyuris* is not to be joined to the Rhabditiformæ; for it has higher structural relations.

Differences are to be detected which perhaps may connect the simplest with the most complicated metamorphosis. In the first place, every Nematode has a larval stage; in this stage all are alike, and all, with few exceptions, lead a free existence, a proof that the parasitic are derived from the free-living forms. But while the parasitic larvæ must of necessity perish if they are unable by any means to reach the interior of other animals, the free-living forms develop into sexually mature worms without changing their abode. But how is it with the Rhabditiformæ? Schneider's investigations have already shown us that most Rhabditidæ require for their development soil or liquid which has become foul; and later experiments appear to establish the conclusion that the development of the Rhabditidæ is carried out in the midst of decomposing matter. *Rhabditis nigrovenosa* and *appendiculata* also require a nidus of filth for their later developmental stages, but have the power of developing into the sexually mature condition in this position, while their nearest allies, the Oxyurids, can only develop within the bodies of other animals. And this development into the sexual state apart from a host characterizes both free-livers and the Rhabditiformæ, while the contrary is the distinguishing mark of the parasites. If we study those Rhabditiformæ which are found in the interior of man and the higher animals, we find, from the researches of various investigators, that these species reach the mature con-

dition just as well out of the body as within it, and that their development is not in the least influenced by the latter position. This rule applies with greater or less accuracy to the other genera which are grouped with Rhabditiformæ. *Anguillula aceti*, it is true, lives in artificially prepared vinegar, but only in the larval state, while it develops sexually and reproduces only in fermented vinegar.

Most of the *Cephalobi* live in roots of moss which have more or less undergone decay; and most Rhabditidæ live in decomposing organic matter, or in earth which contains it. We see, then, that it is just as much a necessity for the Rhabditiformæ to find a resting-place in decomposing matter as it is for the parasitic forms to reach by some means the inside of an animal; while the free-living forms, unfettered by such requirements, develop directly under most varied and independent external conditions. The preservation of the species is effected in different ways; for while the parasites secure this end by producing enormous quantities of ova, with the Rhabditidæ, which produce but few eggs, it is managed by the constant aggregation of the individuals in large numbers and by their extremely rapid development, which occupies sometimes only twenty-four hours; while their tenacity of life and their habit of wandering gives them the power of becoming widely distributed. Some Rhabditiformæ, indeed, appear to occur singly; but this cannot be decided for certain, owing to the imperfect extent to which their habits are known: in cases where isolated individuals are found it is always possible that they may be merely stray members of a colony. It is seldom that the free-living forms live together; they are generally (with the exception of the parasitic *Tylenchi*) to be found singly; they lay very few eggs; and hence the different species are always found to be feebly represented. *Diplogaster rivalis* may be mentioned here as showing a transition to the Rhabditiformæ; for it usually occurs in large numbers in wet ditches among Algæ, and also reproduces, as I have often convinced myself, with great rapidity in decayed Algæ.

Bütschli was the first who endeavoured to unite the genera *Oxyuris*, *Rhabditis*, *Cephalobus*, and *Anguillula*, on account of their agreement in the structure of the caudal termination in males &c.; these genera would seem to be closely allied. De Man has placed them in the family "Odontosphæridæ;" I have called the family Rhabditidæ. De Man associated with them the Plectidæ and Diplogasteridæ; but although I cannot deny the close affinity of these forms with the above-mentioned genera, yet they possess so many of the characters requisite to a free existence that we are justified in sepa-

rating them from the Rhabditiformæ, at least until more exact study shall show other limits to be necessary for the group.

Now the Rhabditiformæ lack all the chief points usually coincident with a free life—namely, the circumoral bristles, lateral circular markings, and caudal sucker. Those structures which have been pointed out in some Rhabditidæ as short bristles around the mouth are rather to be described as long pointed papillæ, and occur in some other parasitic forms as well. Almost all Rhabditidæ possess an œsophagus with either two roundish swellings or one elongated anterior dilatation, and with a terminal bulb provided with a valvular apparatus. An œsophagus of this kind is found elsewhere only in the genera most nearly akin to them (*Plectus*, *Diplogaster*), and in the representatives of the genus *Tylenchus* (the parasite of plants)—a proof that the passage to a parasitic mode of life is marked by a modification of this kind in the structure of the œsophagus. The *Tylenchi*, however, in their other characters are very nearly related to the Rhabditiformæ, inasmuch as the above-mentioned characters are wanting in them; and I hope the time may come when a closer examination will allow us to place them with the Rhabditiformæ as a distinct genus.

Summing up what has been said, we find that there are perhaps few orders in which so continuous a series of forms exists as in the Nematodes. But that it is possible to separate by a transitional group the two divisions distinguished by Bastian I have now endeavoured to show; and even if I have carried out this separation imperfectly, I should still have for consolation the expectation that the careful researches of Leuckart, Claus, Bütschli, and De Man will yet enable us to establish more satisfactory boundary lines.

Although the complete chain of forms is not known to us, and although our present knowledge allows us only tentatively to fix boundaries to the groups, I take the liberty of proposing the following three suborders as those which best represent our knowledge up to the present time.

I. *Nematentozoa*.—Thread-worms completing their early stage in the free condition, their maturity as parasites in the bodies of the higher or the lower animals; the species being perpetuated by the production of immense numbers of ova, whose development is more or less complicated. The cuticle is fairly thick, the mouth provided with papillæ and lips; the buccal cavity and the male caudal end may be either simple or complex. The nervous system consists of distinct nerve-cells and fibres, surrounds the œsophagus, and is always well

developed. The genital tube is complicated by many convolutions.

II. *Rhabditiformæ*.—Small, chiefly microscopic thread-worms, which live generally free, but in exceptional cases as parasites, and have without exception the power of developing to the sexually mature state in organic substances in a state of decomposition, or in earth saturated with such substances, such condition being necessary to the process. The species is perpetuated not so much by the production of an immense number of ova as by the habit which they have of living in colonies, of developing with great rapidity, and with a metamorphosis which is either slight or complicated by dimorphism of the sexes. They are devoid of all the principal characters usually coincident with a free life, such as circumoral bristles, caudal suckers, and lateral circular markings. The cuticle is tolerably thin; the nervous system consists more of fibres than cells, and is feebly developed and often wholly wanting. The œsophagus has two dilatations, the posterior of which is provided with a valvular apparatus. The genital tube is of simple structure, not convoluted. The mouth has lips or papillæ; the buccal cavity is usually very simple.

III. *Anguillulidæ*.—Small microscopic thread-worms leading a free existence in mould or in water throughout all their stages, developing without a complex metamorphosis. Though small, they produce large eggs. Provided with the organs belonging to a free life, such as bristles, caudal sucker, and lateral circular markings, and even with eyes in many cases. Buccal cavity simple or complex, according to the conditions under which they live. The nervous system is either entirely absent or composed only of a few fibres. Genital tube simple; no convolutions.

The Nematodes of the British-Museum collection belong to the Nematentozoa, with the exception of two species which belong to the group Rhabditiformæ; the Anguillulidæ are not represented. With regard to the first group, I must distinctly lay down that not one of the existing classifications represents the true relationships, and we shall certainly have long to wait for a natural arrangement. Of all those which have been proposed I have found that of Schneider to be the best; and although we have found the arrangement according to the muscular system not to be thoroughly satisfactory, I have adopted it provisionally. For this reason, this group includes all the genera contained in Schneider's monograph, with the exception of *Enoplus*, *Pelodera*, *Leptodera*, *Anguillula*, *Mermis*, and *Gordius*; and it is divisible into the subordinate groups, Polymyarii, Meromyarii, and Holomyarii.

For the Polymyarii Schneider enumerates ten genera, of which *Enoplus* is not to be regarded as rightly placed among them, and the genus *Ceratospira* is not represented in the collection. On the other hand, I add to the group the genus *Spiroptera*, lately characterized by Linstow, and the genus *Agamonema* as an appendix, which contains young forms of *Ascaris*, and probably of other genera. For this reason *Agamonema* is not, strictly speaking, a genus at all, but merely a collector's name for various young stages of Nematentozoa. Thus we have ten genera of Polymyarii represented in the collection.

A. **Polymyarii**, Schn.

I. Genus Ascaris, Rud.

Mouth provided with two lips; two spicula of similar form; præanal papillæ to the number of twenty and upwards.

The species are arranged according to the systematic positions of the hosts.

No.	Species.	Species of host.
1.	lumbricoides, *Lin.*	Homo sapiens*.
	,, ,,	Troglodytes niger.
	,, (=suilla, *Duj.*).	Sus scrofa.
2.	incisa, *Rud.*†	Talpa europæa.
3.	mystax, *Schrank.*	Leopardus varius.
	,, ,,	Felis domestica.
	,, ,,	No locality.
3 *a.*	,, var. triquetra.	Canis vulpes.
	,, ,,	No locality.
3 *b.*	,, var. marginata.	Canis familiaris.
	,, ,,	,, aureus.
3 *c.*	,, var. leptoptera.	Felis leo.
	,, ,,	Felis concolor.
3 *d.*	,, var. microptera.	Canis lupus.
4.	transfuga, *Rud.*	Ursus arctos.s
5.	bicolor, *Baird.*	Trichechus romarus.
	,, (?)	No locality.
6.	osculata, *Rud.*	Phoca vitulina.
	,, ,,	,, grœnlandica.
	,, ,,	,, barbata.
	,, ,,	,, annulosa.
	,, ,,	Monachus albiventer.
7.	similis, *Baird.*	Phoca‡.
8.	megalocephala, *Clogn.*	Equus caballus.
9.	Halicores, *Owen.*	Halicore cetacea.

* Specimens of different races.

† Has been considered the young stage of *A. depressa*, Rud.

‡ From Arctartic region.

No.	Species.	Species of host.
10.	simplex, *Rud.*	Phocæna communis.
11.	ensicaudata, *Rud.*	Turdus iliacus.
	,, ,,	,, musicus.
12.	spiralis, *Rud.*	Strix flammea.
13.	unduloso-striata.	Sarcorhamphus papa.
14.	depressa, *Rud.*	Gyps fulvus.
15.	Salvini, *Baird.*	Oreophasis Derbyana.
16.	semiteres, *Rud.*	Vanellus cristatus.
17.	serpentulus, *Rud.*	Ardea cinerea.
18.	microcephala, *Rud.*	,,
19.	spiculigera, *Rud.*	Carbo cormoranus.
	,, ,,	Mergus serratus.
	,, ,,	Colymbus septentrionalis.
	,, ,,	Pelecanus?
20.	holoptera, *Rud.*	Testudo mauritanica.
	,, ,,	,, græca.
21.	sulcata, *Rud.*	,, geometrica.
	,, ,,	,, mauritanica.
	,, ,,	,, græca.
22.	tenuicollis, *Rud.*	Alligator fissiceps.
23.	cephaloptera, *Rud.*	Tropidonotus fasciatus.
	,, ,,	Clotho arietans.
24.	radiosa, *Schn.* (?).	,, rhinoceros.
25.	anoura, *Duj.*	Python molurus.
	,, ,,	Coryphodon pantherinus.
	,, ,,	Coluber corais.
26.	obconica, *Baird.*	Uranops angulatus.
27.	Boddaertii, *Baird.*	Herpetodryas Boddaertii.
28.	truncatula, *Rud.*	Perca cernua.
29.	dentata, *Rud.*	Mullus barbatus.
30.	constricta, *Rud.*	Cottus scorpius.
	,, ,,	Sciæna aquila.
31.	rigida, *Schn.*	Lophius piscatorius.
32.	acuta, *Rud.*	Blennius viviparus.
33.	clavata, *Rud.**	Gadus morrhua.
34.	capsularia, *R.*	,,
	,, ,,	Aphanopus carbo.
	,, ,,	No locality.
35.	mucronata, *Schr.*	Gadus cotta.
36.	collaris, *Rud.*	Platessa flesus.
37.	labiata, *Rud.*	Alepocephalus rostratus.
	,, ,,	Muræna anguilla.
38.	rotundata, *Rud.*	Raia†.
39.	meleagrina, *Kollar.*	Pearl-oyster.
40.	bifaria, *Baird.*	No locality.
41.	lævissima, *Baird.*	,, ,,

* Has been regarded as young stages of different Ascarids.
† From Madeira.

II. Genus Eustrongylus, Dies.

Mouth without lips; mouth-opening circular, surrounded by papillæ. Bursa cup-shaped. One spiculum at the tail-end of the male.

Eustrongylus gigas is the only representative of the genus in this collection. Male and female examples occur from *Sus scrofa* (domestic).

III. Genus Physaloptera, Rud.

Mouth surrounded by two semicircular lips; two spicula, differing in form; a dilated heart-shaped bursa investing the caudal termination. One unpaired papilla in front of, and ten pairs of constant papillæ behind, the anus.

No.	Species.	Species of host.
1.	saginata, *Rud.*	Tityra leuconotus.
2.	alata, *Rud.*	Falco tinnunculus.
3.	megalomastoma, *Rud.*	,, nisus.
4.	sp.? *Sieb.*	Emys venusta.
5.	obtusissima, *Molin.*	Oxyrrhopus plumbeus.
6.	retusa, *Rud.*	From a large *Tropidolepidura.*

IV. Genus Heterakis, Duj.

Mouth trilabiate; lips sometimes so small as to be inconspicuous; two dissimilar spicula; male with sucker in front of anus; three constant præanal papillæ and several postanal ones.

No.	Species.	Species of host.
1.	maculosa, *Rud.*	Columba domestica.
2.	inflexa*, *Rud.*	Tetrao urogallus.
	,, ,,	Gallus gallinaceus.
3.	vesicularis, *Rud.*	Pavo cristatus.
4.	faveolata, *Rud.*	Platessa flesus.

V. Genus Filaria, Müller.

Filaria, Rud.
Spiroptera, Rud. (in part).
Lyorhynchus, Rud.

Mouth-parts showing the greatest variety in form; two dissimilar spicula; four præanal papillæ.

I here describe two new species, and point out one young form.

* *Ascaris inflexa*, Rud.

Filaria spiralis, n. sp. (Pl. X. fig. 2, *a*, *b*.)

Female: length 1·1 millim., breadth 0·46 millim.; length of the body to that of the œsoph. = 7 : 1; length of the body to that of the tail = 40 : 1.

Body of nearly the same breadth throughout; head compressed anteriorly, termination of tail acute. Mouth surrounded by six small lips, containing a quantity of pulp; the two lateral of these lips are somewhat larger than the four median, which, however, are provided with a tooth-like process. The lips are stout, and are so closely appressed that it is very difficult to separate them. The mouth leads into a small vestibule. The cuticle is elevated into six dermal lobes, corresponding to the lips; these are connected together and form a kind of tube over the head; they are especially characteristic of our worm; their edges are smooth, not toothed. Height of the tube 0·1 millim. The œsophagus appears to consist of a short, strongly fibrillated portion, and an opaque richly granular part, which is nearly twelve times as long. The intestine is formed of a number of rows of polyhedral cells, and is coiled in its more posterior portion. The female generative organs were incompletely developed in the specimens under examination; but the vulva was observed at the sides of the anterior end of the head. Of the ten specimens, not one was a male.

The cuticle is thrown into well-marked rings, except at the head and tail, which are smooth.

This worm was found encapsuled between the serous and muscular layers of the stomach of an Australian frog, *Heiloporus albopunctatus*? It was coiled up very much like *Trichina spiralis*; and hence its specific name. It differs in very many points from any *Filaria* which has yet been found encapsuled in the Amphibia; and I cannot identify it with any described *Filaria* or *Spiroptera*.

Filaria ecaudata, mihi (= *F. obtusa*, Rud.).
(Pl. X. fig. 1, *a*–*d*.)

Male, length 35 millim.; female 80 millim. Breadth 3 millim.; length of the body to that of the œsoph. = 20 : 1; length of the body to that of the tail = 1000 : 1.

Body of the same breadth throughout and rounded; the head and tail terminate acutely. Head rounded off, pretty broad. Mouth small, round, with six papillæ; it leads directly into the œsophagus, which is so constricted anteriorly by the connexion between the lateral lines, that it is divided into an anterior and a posterior portion. The latter passes directly, and without the intervention of a bulb, into the intestine. In

the former there are the two horny structures resembling triangular teeth which have been already described by Dujardin and Schneider. The intestine is nearly straight, and is made up of a large number of cells. The rectum is an extremely fine long chitinous tube; anus quite at the tip of the tail, the orifice can only be made out with the aid of high powers. The tail is not widened out, but is rounded and has much the same form in the male and female. The coils of the ovaries are very numerous, and extend from the caudal end as far as the anterior portion of the œsophagus. A large number of ova were found in the cœlom. Vulva 0·1 millim. from the end of the head. A long and much coiled testis extends from the commencement of the intestine to the anus, and fills up the body-cavity. The seminal ducts are extremely short. Two unequal spicula. Four pairs of papillæ, at the margin of the end of the tail, around the anus; there are no papillæ behind the anus. The males appear to be more common than females.

Found in *Lamprotornis æneus*; organ not given.

I feel no doubt that this worm is identical with the *Filaria obtusa* of Rudolphi, and that it is closely allied to *F. pungens*, Schn., from which, however, it is specifically distinct, on account of the form of its tail and the absence of papillæ behind the anus of the male. The free end of the horny process in the œsophagus does not form a denticulate projection; nor is the head more pointed than the tail. Again, the anus of *F. pungens* is situated further forwards than it is in *F. ecaudata*. I have found it necessary to make a change in the specific name, in consequence of Schneider's discovery that *Spiroptera obtusa* is a *Filaria*. I have endeavoured by correct description and figures to fix the characters of this species.

Filaria, sp.? (Pl. X. fig. 3, *a* & *b*.)

Length 1·35 millim., breadth 0·5 millim.; length of the body to that of the œsoph. = 10 : 1; length of the body to that of the tail = 100 : 1.

Body tapering gradually towards either end, and terminating in a sharp tail. Mouth without lips, surrounded by six very small papillæ. A short delicate pharynx leads into the œsophagus, which is fairly muscular at its commencement and termination; it gradually passes into an oval enlargement. The intestine is straight and is constricted at some points; its wall, which is formed of a number of small polyhedral cells, is enormously thick. The anus is somewhat puffed out by elevations of the cuticle; the anus is near the tip of the tail. The cuticle is very strong and so finely ringed as to appear to be almost smooth. The two lateral areas are espe-

cially well developed, and the lateral vessels, which branch repeatedly and give off ramules in all directions, are very characteristic. The lateral vessels unite in the region of the œsophageal enlargement; the strongly chitinized efferent duct opens on the ventral side at about the middle of the œsophagus. Sexual organs still undeveloped.

In many points this worm resembles *Agamonema piscium*, Rud., a form which has indeed been found by Van Beneden in the bat; there seem, however, to be important differences. As I have as yet been only able to examine one specimen, I will not describe the species as new; on the other hand, no *Filaria* has ever yet been found under the skin of a bat; and as this was found in a very rare species from Guatemala (*Diclidurus albus*), I have thought it right to give a description of it.

No.	Species.	Species of host.
1.	medinensis, *Gmelin.*	Homo sapiens.
2.	gracilis, *Rud.*	Lagothrix Humboldtii.
	,, ,,	Ateles ?
	,, ,,	Cebus capucinus.
3.	sp. ? (young stage).	Diclidurus albus.
4.	strumosa, *Rud.*	Talpa europæa.
5.	n. sp., *Sieb.**	,, ,,
6.	obtusa, *Rud.*	Mus musculus.
7.	sanguinolenta, *Rud.*	Canis familiaris.
8.	quadrispina, *Dies.*	Mustela frenata.
9.	nasicola, *Duj.*	Putorius fœtidus.
10.	strongylina, *Rud.*	Sus scrofa (domestic).
11.	megastoma, *Rud.*	Equus caballus.
12.	papillosa, *Rud.*	,, ,,
13.	microstoma, *Schn.*	,, ,,
14.	inflexocaudata, *Sieb.*	Phocæna communis.
15.	Sturni, *Pall.*	Sturnus vulgaris.
16.	ecaudata, *mihi* †.	Hirundo urbica.
	,, ,,	Lamprotornis æneus.
17.	anthuris, *Rud.*	Corvus cornix.
18.	laticeps, *Rud.*	Falco tinnunculus.
19.	leptoptera, *Rud.*	,, buteo.
20.	attenuata, *Rud.*	,, peregrinus.
	,, ,,	Corvus cornix.
21.	horrida, *Dies.*	Rhea americana.
22.	spiralis, n. sp.	Heiloporus albopunctatus ?‡.
23.	sanguinea, *Rud.*	Galaxias scriba.
	,, ,,	Osmerus eperlanus.
	,, ,,	Cyprinus erythrophthalmus.
	,, ,,	Anguilla fluviatilis.

* = *F. strumosa*, Rud. † = *F. obtusa*, R.

‡ An Australian frog.

VI. Genus Spiroptera, Linstow.

Spiroptera, Rud. (in part).

Mouth-parts various in form; two dissimilar spicula; eight præanal papillæ. Bursa asymmetrical.

No.	Species.	Species of host.
1.	euryoptera, *Rud.*	Lanius minor.
2.	adunca, *Crepl.*	Larus argentatus.
3.	crassicauda, *Mehlis.*	Colymbus septentrionalis.

VII. Genus Agamonema, Dies.

No constant characters can be assigned; contains young forms of Nematodes, which are chiefly to be found encysted in fishes. No good species exist; those assigned to it were established by the older investigators.

No.	Species.	Species of host.
1.	communis, *Dies.*	Labrax lupus. Aphanopus carbo. Gadus morrhua. Salmo salar.
2.	bicolor, *Dies.*	Osmerus eperlanus.
3.	capsularia, *Dies.*	Clupea alosa.
	" "	Merlucius valparaiso.

VIII. Genus Ancyracanthus, Dies.

Mouth-parts various in form. Mouth-opening small; two dissimilar spicula; from fifteen to twenty papillæ, arranged in a line singly or in pairs.

No.	Species.	Species of host.
1.	cystidicola, *Rud.*	Salmo fario.
2.	impar, *Rud.* (?).	" "

IX. Genus Hedruris, Creplin.

Head with four lips; two dissimilar spicula; two præanal papillæ.

No.	Species.	Species of host.
1.	androphora, *Nitsch.*	Triton cristatus.
2.	siredonis, *Baird.*	Siredon mexicanus.

X. Genus Cucullanus, Müller.

The mouth traverses the entire breadth of the head in the

form of a slit leading into a circular mouth-capsule; two similar spicula; seven to eight præanal papillæ.

Two species occur from two hosts.

No.	Species.	Species of host.
1.	microcephalus, *Duj.*	Emys guttata.
2.	elegans, *Zed.*	Muræna anguilla.

B. Meromyarii, Schn.

Of the Meromyarii Schneider enumerates ten genera, of which *Leptodera* and *Pelodera* (both = *Rhabditis*, Duj.) are not to be regarded as rightly placed among them; and *Labiduris* and *Dermatoxys* are not represented in the collection.

XI. Genus Nematoxys, Schn.

Mouth provided with three very small lips; two similar spicula. Body covered with many papillæ both in male and female.

Nematoxys ornatus, Duj., is the only representative of the genus in this collection, from *Rana esculenta*.

XII. Genus Oxysoma, Schn.

Mouth provided with three lips, asymmetrical. Two similar spicula; three præanal papillæ constant.

No.	Species.	Species of host.
1.	brevicaudata, *Zed.*	Bufo variabilis.
	,, ,,	Anguis fragilis.
2.	acuminata, *Rud.*	Rana temporaria.

XIII. Genus Oxyuris, Rud.

Ascaris, Rud. (in part).
Passalurus, Duj.
Orolaimus, Duj.
Stychocephalus, Dies.

Lips very inconspicuous; two dissimilar spicula. Bursa present or absent.

No.	Species.	Species of host.
1.	vermicularis, *Rud.*	Homo sapiens.
2.	obvelata, *Rud.*	Mus musculus.
3.	ambigua, *Rud.*	Lepus timidus.
4.	tetraptera, *Nitz.*	Mus sylvaticus.
5.	curvula, *Rud.*	Equus caballus.

XIV. Genus Atractis, Duj.

Lips inconspicuous; two dissimilar spicula; three præanal papillæ.

Atractis dactylura, Duj., is the only representative of the genus in this collection, from *Testudo græca*.

XV. Genus Spiroxis, Schn.

Mouth provided with two lips; two dissimilar spicula of large size.

Spiroxis contorta, Schn. (?), is the only representative of the genus in this collection, from *Emys europæa*.

XVI. Genus Strongylus, Rud.

Dochmius, Molin.
Ancylostomum, Dubini.
Sclerostoma, Rud.
Diaphanocephalus, Dies.

Mouth-parts various in form; buccal cavity with chitinous teeth; two similar spicula. Bursa funnel-shaped.

No.	Species.	Species of host.
1.	striatus, *Zed.*	Erinaceus europæus.
2.	trigonocephalus, *Rud.*	Canis familiaris.
3.	annulatus, *Sieb.*	,, lupus.
4.	dispar, *Dies.*	Felis concolor.
5.	clathratus, *Baird.*	Loxodonta africana.
6.	sipunculiformis, *Baird.*	Elasmodon indicus.
7.	filaria, *Rud.*	Ovis aries.
8.	micrurus, *Mehlis.*	Sus scrofa.
9.	paradoxus, *Mehlis.*	,, ,,
10.	armatus, *Rud.*	Equus caballus.
11.	tetracanthus, *Dies.*	,, ,,
12.	trachealis, *Sieb.*	Perdix cinerea.
	,, ,,	Gallus gallinaceus.
13.	nodularis, *Rud.*	Anser cinereus.
14.	mucronatus, *Baird.*	Phymatura palluma.
15.	auricularius, *Rud.*	Rana temporaria.

C. Holomyarii, Schn.

Of the Holomyarii Schneider enumerates eight genera, of which *Anguillula*, *Mermis*, and *Gordius* are not to be regarded as rightly placed among them, and two genera are not represented in this collection; on the other hand, I add to the group the genus *Trichodes*, lately characterized by Linstow. Thus we have four genera of Holomyarii represented in the collection.

XVII. Genus Trichosoma, Rud.

One spiculum ; vagina protrusible.

No.	Species.	Species of host.
1.	contorta, *Creplin.*	Corvus frugilegus.
2.	resecta, *Duj.*	,, ,,
3.	brevicollis, *Rud.*	Anser cinereus.

XVIII. Genus Trichodes, Linstow.

Trichodes, Linstow, Troschel's Archiv, 1874, i.

No spicula; no bursa. Male in the oviducts of female during copulation.

Trichodes crassicauda, Bllg., is the only representative of the genus in this collection, from *Mus decumanus.*

XIX. Genus Trichocephalus, Goeze.

Body hair-like at anterior and thick at posterior end. The caudal end of male screw-shaped.

No.	Species.	Species of host.
1.	dispar, *Rud.*	Homo sapiens.
2.	unguiculatus, *Rud.*	Lepus timidus.

XX. Genus Pseudalius, Duj.

Two similar spicula. Bursa bilobate, spoon-shaped, or wanting. Papillæ numerous.

No.	Species.	Species of host.
1.	inflexus, *Rud.*	Phocæna communis.
2.	convolutus, *Dies.*	,, ,,
	,, ,,	Globiocephalus svineval.
3.	minor, *Dies.*	Phocæna communis.

Rhabditiformæ.

Rhabdonema nigrovenosa, Leuck. (=*Ascaris nigrovenosa,* Rud.), and *Rhabditis elongata* (=*Leptodera elongata,* Baird) are the only representatives of the suborder in this collection ; the former occurs from *Rana temporaria,* the latter from *Siredon mexicanus.*

EXPLANATION OF PLATE X.

Fig. 1. *Filaria ecaudata,* mihi: *a,* head of male, mag. 70 diam.; *b,* tail of male, mag. 70 diam.; *c,* head of female, mag. 70 diam.; *d,* tail of female, mag. 70 diam.

Fig. 2. *Filaria spiralis,* n. sp.: *a,* head of female, mag. 70 diam.; *b,* tail of female, mag. 70 diam.

Fig. 3. *Filaria*? (young stage): *a,* tail, enlarged; *b,* part of the body, showing the ramifications of the lateral vessels, mag. 70 diam.

XXXI.—*New Species of Geodephagous Coleoptera from North-west Mexico.* By H. W. Bates, F.R.S.

THE following new species form part of a collection recently received by Messrs. Godman and Salvin from their correspondent, Mr. Forrer, and are here published in anticipation of the Supplement to Coleoptera, vol. i., of the 'Biologia Centrali-Americana,' in which work all the species of the same collection will be recorded. They were collected on the elevated plateau inland from Mazatlan and in the State of Durango, a part of Mexico the zoology of which is but little known. It will be a surprise to coleopterists to hear of the occurrence so far south of the genera *Carabus* and *Cychrus*, hitherto unrecorded from Mexico or any part of Tropical America, and especially to learn that the species are not allied to northern species of the Pacific slope or the Rocky Mountains, but to forms peculiar to the Atlantic States of North America. The section *Scaphinotus* of the genus *Cychrus* is especially characteristic of the Atlantic States.

Cicindela euthales.

C. Catharinæ quoad formam similis, sed corporis lateribus nudis. Viridis, opaca, fronte, sutura lateribusque elytrorum nitidis; labro albo margine antico medio late producto tridentato, utrinque sinuato, angulis rectis; fronte verticali utrinque (et vertice) subtilissime striata; capite inter oculos haud concavo; palpis nigris; thorace transverso, lateribus albo pilosis vix rotundatis, antice angulatis, dorso transversim indistincte striguloso; elytris apice conjunctim rotundatis, dorso haud conspicue sculpturatis, immaculatis: corpore subtus viridi-nitido, lateribus cupreo-violaceis nudis; pedibus cupreis.

Var. nigra, opaca, abdomine medio et apice nitido; labro albo.

Long. $4\frac{1}{2}$–$5\frac{1}{2}$ lin. ♂ ♀.

Hab. Mexico, Ciudad, Durango (*Forrer*).

Of similar form to *C. Catharinæ*, but more closely allied to *C. ioessa*, in the elytra not being visibly sculptured and in the naked sides of the body beneath. It differs from *C. ioessa* by the fore-head being more vertical and distinctly strigose on each side, and (in the green form) by the different colour of the side margins of the elytra and the under surface of the body.

Cicindela nephelota.

Minus elongata, postice paullo dilatata, supra fusco-ænea opaca nigro-fusco varia, elytris vitta marginali (ab humero usque ultra medium continuata, post humerum a margine paullulum remota)

intus ramulos duos emittente, primum brevem, secundum obliquum, subrectum versus suturam extensum, lunula apicali et gutta antico-discoidali albis; labro albo antice medio paullulum producto denticulato, utrinque sinuato, angulis subrectis; palpis rufo-testaceis, articulis apicalibus cupreo-æneis; capite toto valde strigoso, inter oculos paullo concavo; thorace parvo, lateribus medio rotundatis nec angulatis, disco utrinque convexo, longe incumbenti-piloso, striguloso; elytris inæqualibus, haud profunde punctatis, signaturis albis, albo-fusco marginatis; corpore subtus nitido, cyaneo, pectoris lateribus igneo-cupreis parce pilosis; pedibus cupreis.

Long. $3\frac{3}{4}$–$4\frac{1}{4}$ lin. ♂ ♀.

Hab. Mexico, Ciudad, Durango (*Forrer*).

This curious little species is not closely allied to any *Cicindela* known to me. It seems to approach nearest *C. semicircularis.*

Carabus Forreri.

Elongatus, niger, subnitidus, capite lævi, epistomate utrinque fovea profunda, labro medio excavato; thorace lævi, lateribus fere æqualiter arcuatis, margine explanato fortiter reflexo, angulis posticis longe productis apice obtusis; elytris elongato-ovatis obsoletissime striato-punctulatis punctisque majoribus triplici serie; abdominis segmentis 3 apicalibus basi transversim sulcatis.

Long. $10\frac{1}{2}$ lin. ♀.

Hab. Mexico, Ciudad, Durango (*Forrer*).

Of the elongate and narrow form of *C. Agassizii* and *C. tædatus*, but the thorax quite different from either of those species, being smooth, broadly margined, and approaching in shape that of *C. sylvosus.*

Cychrus (*Scaphinotus*) *mexicanus.*

Oblongus, niger, subviridi-tinctus; thorace cordato-quadrato, margine antico ut in *C. elevato* emarginato utrinque rotundato, postice multo magis angustato, angulis posticis longe productis acutis, margine laterali minus quam in *C. elevato* explanato-reflexo; elytris anguste oblongo-ovatis, humeris obtuse rotundatis valde explanato-reflexis, dorso punctato-striatis; abdominis segmentis 3 terminalibus basi transversim sulcatis; metasterno et abdomine impunctatis; epipleuris rugoso-punctatis.

Long. $9\frac{1}{2}$ lin. ♂ ♀.

Hab. Milpas, Durango, Mexico, alt. 5900 feet (*Forrer*).

Of much narrower and less ovate form than *C. elevatus* or any other species of the genus, resembling at first sight a *Carabus*, e. g. *C. Preslii.* The explanated and turned-up

margins of the thorax and base of the elytra are of the same nature as in *C. excavatus*, but much narrower; and the thorax is rather strongly narrowed behind. The epipleuræ of the elytra are more feebly rugose-punctate than in *C. excavatus*; and the sides of the metathorax and basal ventral segments, instead of being sculptured as in that species, are smooth.

XXXII.—*Descriptions of new* Cetoniidæ, Buprestidæ, *and* Cerambycidæ *from Madagascar*. By Charles O. Waterhouse.

The species described in this paper were received by the British Museum in a collection recently brought to this country by the Rev. W. Deans Cowan, to whom we are already so much indebted for numerous interesting novelties. They were chiefly collected a few miles to the north of Fianarantsoa.

Cetoniidæ.

Euchrœa flavoguttata.

Statura *E. histrionicæ*, nigra; capite ochraceo, linea mediana nigra; thorace ochraceo cruce discoidali nigra; elytris velutinis, singulis guttis novem ochraceis; pygidio utrinque ochraceo.
Long. 11 lin.

The thorax is shining, finely and not very thickly punctured; the yellow colour occupies about half the surface, leaving the narrow lateral margins, the base, and a cross on the disk black. Scutellum black and smooth. There is a yellow spot on each epimeron. Elytra dull and velvety, each with nine yellow spots, viz. two between the suture and the first costa, three between the first and second costæ (two near the base and one beyond the middle), three on the sides, and one at the apex. The pygidium is chiefly yellow; but the base, the middle, and a small spot (in the yellow) on each side are black. There are two transverse yellow spots at the side of the third, fourth, and fifth abdominal segments, and one on the side of the first and sixth segments; there is one below the anterior angle of the thorax, and three at the sides of the sterna.

From another source there is in the British Museum an example which has the thorax black, with ten yellow spots,

two on each lateral margin and three in a longitudinal line on each side of the disk. The spots on the elytra are also smaller. I believe this to be merely a variety.

Coptomia olivacea.

Olivacea, nitida: thorace utrinque punctis nonnullis impressis, marginibus incrassatis; elytris striis impressis (striis in fœmina punctatis), apice ruguloso: pygidio transversim confertim strigoso.
Long. 7–8 lin.

At first sight this might be mistaken for *C. mauritiana*; it is, however, of a more olive-green, and is much shorter, etc. The thorax is relatively a little shorter and broader, smooth, except some rather large punctures near the hinder angles. The elytra are relatively shorter; and the apical callosity is a little further removed from the apex; each elytron has three pairs of impressed lines (besides some interrupted lateral ones); these are strongly punctured in the female, smooth in the male. The apex is rugulose-strigose, the rugosity extending along the side of the apical callosity. The pygidium is moderately convex and alike in the two sexes. The sternal process is very strong, not quite so long as in *C. mauritiana*, rather more triangular when viewed from below, much broader at the base when viewed laterally. The abdomen in the female is punctured in the same way with few punctures as in the same sex of *C. mauritiana*; but in the males there is more punctuation and more pubescence.

The anterior tibiæ in the male are simple, in the female tridentate.

Coptomia modesta, Waterh.

(Ann. & Mag. Nat. Hist. 1879, iv. p. 81.)

This species is most variable in colour; but the uniform green form with pitchy legs is by far the commonest.

Var. 1. Pale yellowish green, with yellow elytra.

Var. 2. Reddish yellow, with the back of the head, the discoidal area of the elytra, the sterna, and base of the abdomen dark green.

Var. 3. Grass-green; elytra yellow, with the suture, margins, and the space between the two discoidal striæ green.

Var. 4. Black; the elytra brown, with the space between the discoidal striæ and the margins black.

Var. 5. Black, with the tibiæ and tarsi pitchy.

Var. 6. Like var. 3, but with a white line or spot on each side of the first to fourth abdominal segments, and a large white patch on each side of the pygidium.

The elytra have frequently a bluish tinge. The species which I described as *C. elegans* (Ann. & Mag. Nat. Hist. 1879, iv. p. 79) is only a variety of this species, somewhat like var. 3, but with only a green spot on the disk of the elytron, the suture only green at the apex.

As a rule there are no white spots on the sides of the abdomen; but frequently there is a white line on each side of the basal segment. I have only seen one example with white on the pygidium, as in var. 6.

Stenotarsia (*Linotarsia* *) *plagiata*.

Picea; thorace elytrisque fulvo-flavis, opacis, illo plagis duabus (plus minusve confluentibus) nigris, elytris singulatim plagis duabus nigris.

Long. 6–7 lin.

I have had specimens of this species for some time separated from *Stenotarsia Scotii*, Janson, but did not, until I had seen more examples, venture to describe it as a distinct species. It differs from *C. Scotii* in having the clypeus much more densely punctured. The thorax (instead of being nearly round) is more narrowed in front, and is altogether rather broader; it generally has two black patches on the disk; but these are sometimes united. The scutellum is yellowish, but pitchy at the base. The elytra are more narrowed towards the apex, have the shoulders more prominent; and the round spots of *S. Scottii* are replaced by more quadrangular spots, which sometimes cover the greater part of the elytra.

Anochilia punctatissima.

Nigra, sat lata, subdepressa, punctatissima; thoracis lateribus vittaque humerali ferrugineis. ♀.

Long. 12 lin.

Allied to *A. republicana*, Coq., but larger and broader, and at once distinguished by the whole of the upper surface of the insect being densely and strongly punctured, the sides of the thorax and elytra being especially rugose. The scutellum is smooth in the middle. The thorax is much broader than in *A. republicana*, and has the sides from the middle to the base parallel; the lateral margins are incrassate and reddish. Pygidium transverse, transversely rugose at the apex, and strigose at the base. The sternal process is very short and transverse. The underside of the insect is shining, but coarsely punctured. The anterior tibiæ are tridentate; the posterior tibiæ are fringed on the inner side with long black

* Kraatz, Deutsch. ent. Zeit. 1880, p. 306.

hair. The rusty red stripe on the elytra extends from the base at the shoulder to beyond the middle.

Buprestidæ.

Pycnobothris dejecta.

Elongata, sat angusta, subparallela, parum nitida, ænea; thorace crebre punctato, elytris perparum angustiore, parallelo, ad apicem solum subito oblique angustato; elytris subparallelis, ad apicem angustatis, fortiter striatis, striis punctatis, singulatim maculis duabus rotundatis marginalibus tomentosis ornatis, apice truncato: corpore subtus æneo, rugoso; abdominis segmento ultimo crebre punctato et piloso, plaga mediana ovali nitida lævi cuprea.
Long. 9 lin.

This species is nearest to *P. compacta*, Waterh. (Trans. Ent. Soc. 1880, p. 194), but is narrower and more parallel. The thorax is rather strongly and closely punctured; the median impression is scarcely noticeable. The elytra are behind the middle a little wider than at the shoulders, then narrowed to the apex; the striæ are strongly impressed, and are well-marked, even at the sides; the interstices near the suture are moderately convex, those towards the sides are slightly wrinkled by the punctures in the striæ; the second interstice has five or six small round pilose impressions; on the margin, a litttle way below the shoulder, is an ovate impression (filled with yellow pile); and here there is a slight dilatation of the margin; there is a second similar impression about halfway between the middle and the apex; the apex is narrowly truncate, but not compressed. The underside of the insect is rugose. The prosternal process is deeply lined on each side, densely and finely punctured and pilose in the middle in the male, sparingly punctured and not pilose in the female. Apical segment of the abdomen closely punctured and pubescent, with an ovate highly polished coppery space in the middle, extending from the base to the apex, narrower than in *P. compacta.*

Pycnobothris quadrimaculata.

Elongata, parallela, sat convexa, parum nitida, latera versus opaca, obscure ænea; thorace elytris perparum angustiore, transverso, sat crebre punctulato, linea mediana impressa, lateribus parallelis, ad angulos anticos solum subito incurvatis; elytris post medium paulo latioribus, dein arcuatim angustatis, ad apicem truncatis, punctato-striatis, maculis quatuor rotundatis impressis et flavo-tomentosis; corpore subtus plagis guttisque cyaneis ornato; abdominis segmento ultimo punctato, lineis duabus longitudinalibus elevatis cyaneis instructo.
Long. 10 lin.

Very like *P. ruficauda*, Th., in general colour and sculpture, but much more parallel in form; the thorax scarcely narrower than the elytra, parallel at the sides to very near the front angles, then suddenly obliquely narrowed. The elytra are not at all expanded below the shoulders; the broadest part is behind the middle; the three or four dorsal lines are impressed, the rest are only lines of fine punctures; the second interstice has a line of small punctiform pilose impressions, and there are numerous others on other parts of the elytra; each elytron has two large round impressions, the first is at the middle of the elytron, not quite touching the margin; and attached to this is a small spot on what would be the fourth interstice; the second large spot is close to the apex; the apex is narrowly truncate and pilose (not compressed), the outer angle dentiform. The prosternal process is moderately thickly punctured, with a strongly impressed line on each side. The middle of the metasternum is almost smooth, but has a median impressed line. The apical segment of the abdomen has two longitudinal smooth lines; I know of no other species which has this character.

Coccinellopsis sobrina.

Ovalis, sat convexa, fere nigra, sat nitida; elytris singulatim maculis tribus auratis impressis, marginibus impressis sat crebre punctulatis; corpore subtus cupreo; abdominis segmento ultimo polito, ad basin punctato, et in medio punctis nonnullis asperso.
Long. 10–13 lin.

Very close to *C. auriventris*, L. & G., and scarcely to be distinguished on the upperside from that species. It differs below in the apical segment of the abdomen. This segment in *auriventris* is smooth, with a triangular punctured space at the base on each side, bounded by a pubescent oblique line; the middle of the base is left smooth. In *C. sobrina* the punctuation is carried all across the segment at the base, and the middle portion is also always more or less punctured.

The colour of the underside is less bright than in *C. auriventris*, and is more or less purple-coppery; and the reflexed margins of the elytra are bluish green.

One specimen has a little brassy colour at the sides of the sterna and on the femora; and the reflexed margins of the elytra are coppery.

Coccinellopsis læviventris.

Fusco-ænea, nitida, sat lata, antice et postice attenuata; elytris convexis, ad apicem declivis, guttis nonnullis pilosis impressis,

apice anguste truncato, corpore subtus parce punctulato, prosterno elytrorumque marginibus violaceis.

Long. $10\frac{1}{2}$–12 lin.

Quite unlike any species known to me. In some respects it calls to mind *Amphisbeta impressipennis* in general colour, the character of the spots, the slight truncature of each elytron, the absence of any distinct anal plate, &c.; but the shorter form, expanded and concave under margins of the elytra, oblige me to place it in the genus *Coccinellopsis*. The broadest part is about the middle; and the insect is much narrowed anteriorly and posteriorly. The thorax is longitudinally impressed in the middle, and very lightly impressed on each side; moderately thickly and rather finely punctured. The elytra have no distinct shoulders; that is, they are at the base not wider than the thorax, and gradually become wider to the middle; the discoidal area before the middle is very convex, the sides slope down, and the apical portion slopes down very much; the margins are not at all reflexed, finely punctured; there are fine punctured lines on the dorsal region; there are numerous small pilose punctured impressions (particularly posteriorly), and there are three rather larger round spots on each elytron, one below the slight humeral callosity, one about the middle, and another between that and the apex. On the underside, the sides of the sterna and the posterior coxæ are of a more brassy colour. The prosternal process and the middle of the metasternum are almost without punctures, flat, and of a purple colour. The abdomen is sparingly punctured, very shining, finely pilose at the sides; the apical segment is sparingly punctured, about as long as broad, triangular, with the apex rounded. The under margins of the elytra are violet, with a reddish-brown tint at the base.

Cerambycidæ.

Artelida aurosericea.

Flava, dense aureo-pilosa; antennis fuscis, elytrorum apice parum infuscato; tibiis posticis ad apicem dilatatis, hirsutis. ♀.

Long. $7\frac{1}{2}$ lin.

This species is close to *A. crinita*, Th. (Syst. Ceramb. p. 143), but differs in being of a brighter yellow, clothed with more golden pubescence, in having the antennæ brownish (except at the base); the abdomen is yellow; and the apical half of the posterior tibiæ is also yellow and rather less dilated. The lateral tubercles of the thorax are short and conical; there are four tubercles on the dorsal region, but they are very slight and obtuse. The elytra are obtuse at the apex, but not dis-

tinctly truncate. The fifth segment of the abdomen is slightly emarginate in the middle of the apex, a character which is not visible in *A. crinita.*

M. Thomson states that the example in Chevrolat's collection is a male. If he is referring to the specimen which was in that collection when it came to the British Museum, I think he is in error. The specimen appears to me to be (as well as one since received) a female. The male would undoubtedly have the claw-joint dilated, as in the allied species; and the structure of the antennæ and abdomen appear to denote the female sex.

Leptocera rufofemorata.

Nigra, subopaca; capite thoraceque crebre punctatis; elytris violaceis, subseriatim crebre punctatis; femoribus anticis rufis.
Long. 6 lin.

Closely allied to *L. humeralis*, Buq., and of the same form, except perhaps the elytra, which are a trifle more parallel. The antennæ are longer than the whole insect, the basal joint thickly punctured, the third to the eleventh joints clothed with grey pubescence. The thorax is rather long, very thickly punctured, and rather more finely punctured than in *L. humeralis*, the sides very gently arcuate. The elytra are very thickly punctured, rather strongly so near the base, more finely at the sides and apex; on the disk near the base the punctures form lines; the suture is lined with grey pubescence; the apex is slightly truncated, but the outer angle is not so dentiform as in *L. humeralis.* The femora are strongly inflated; the anterior bright red, except at the base and extreme apex. The middle femora have an obscure red line above.

Leptocera pulchra.

Nigra, opaca; antennis piceis; thorace creberrime punctulato, lateribus leviter arcuatis; elytris subparallelis, viridibus vage aureotinctis, coriaceis atque vermiculosis, crebre subtiliter punctulatis, apice obtuso, cupreo; abdomine parum nitido, sat crebre punctato.
Long. 11–12 lin.

Antennæ rather thick; in the male considerably longer than the whole insect; in the female they scarcely reach to the middle of the elytra; the basal joint is thickly punctured with larger and smaller punctures. Thorax about as long as broad, slightly narrowed in front and behind, suddenly constricted in front, immediately before the front angles; the anterior and posterior margins thickened; the surface is densely covered with very small and larger punctures. The elytra are only slightly narrowed towards the apex, green with golden and

blue tints in parts. The sculpture is peculiar, consisting of very dense extremely fine punctuation on a wrinkled surface, with small punctures scattered over the more raised intervals. Viewing the insect laterally, there is a whitish pubescent line below the eye, continued along the flanks of the thorax and onto the metathoracic epipleura. The legs are thick, and the femora much inflated, more or less clothed with pale grey pile.

XXXIII.—*Descriptions of some new Species of Myriopoda of the Genus* Spirostreptus *from Madagascar.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

The species here described were obtained at Ankafana, Betsileo country, by the Rev. Deans Cowan.

1. *Spirostreptus Cowani*, sp. n.

Black, with the head, antennæ, nuchal plate, legs, preanal and anal segments, and a transverse dorsal band on the front of all the other segments bright red.

Body long, smooth, but not polished, very slightly attenuated in front and behind; head large, semicircular when seen in front; clypeus bilobed, the lobes rounded, scarcely separated, excepting by a small conical notch in front, on each side of which is a single puncture, smooth. Antennæ with rather short joints, excepting the second, which is half as long again as the third, the latter being slightly longer than the remaining joints, smooth, cylindrical, the first to fifth attenuated towards the base, with a few scattered bristles, increasing in number towards the sixth joint, which is rather densely setose and of a short oval form; the seventh joint is a mere terminal button; ocular plates semicircular, transverse, composed of six transverse and five or six oblique facets; nuchal plate with a lateral indentation in front near to the margin, but not extending into the dorsal region, terminating on each side in an obtusely triangular lobe, feebly striated along its inferior margin; second segment much prolonged below, deeply depressed above the anterior border, coarsely rugulose striate, remaining segments up to the preanal one finely and sparsely reticulate-striated, excepting at the sides, where the striation becomes deeper and denser, divided into two parts by a deep depression just beyond the middle, behind which they are very distinctly tumid; preanal segment terminating above in an obtuse angle, its lateral margins being oblique and very slightly concave; preanal plate transverse, elongate-triangular, obtusely keeled in the centre, and with an obtuse terminal angle; anal plates broadly and obtusely carinate at the mar-

gins; fifty-three segments in all; legs rather long, the second and third joints long and compressed.

Total length 114 millim., or about $4\frac{1}{2}$ inches; width of nuchal plate 9 millim., at centre of body 11 millim., of preanal segment 7 millim.

Evidently quite a common species in the Betsileo country.

2. *Spirostreptus trachydermus*, sp. n.

Black, with the clypeus reddish, the antennæ and legs bright ochre-yellow.

Body very long, dull, distinctly attenuated in front, but very slightly so behind; head rather small, smooth, elongated, almost quadrate when viewed in front; clypeus bilobed, the lobes being angulated, divided in front by a broad conical excision. Antennæ with rather long joints, the second and third joints especially, the second nearly half as long again as the third; smooth, scarcely setose, cylindrical, the joints attenuated behind, the sixth pyriform, the seventh a very small button; ocular plates forming an oblique semielliptical patch, the anterior edge of which is occupied by eleven facets, whilst the series, counted from the inner margin, consist of eight facets from the first to the fourth series; nuchal plate with two deep indentations at the sides in front, followed by two shorter indentations, again succeeded by a fifth, which runs obliquely from the posterior to the anterior margin; the dorsal surface in front is deeply reticulated, the indented markings becoming wider towards the middle, and changing at the back into short longitudinal striæ; the dorsal segments are smooth in front, and show under a high power a series of extremely fine embossed transverse lines; the posterior portion of the front half of the segments is finely granulose, and divided from the posterior half of the segments by a deep sulcus; posterior portion tumid, rugose, and crossed longitudinally by numerous deep longitudinal indentations; preanal segment coarsely reticulate, very narrow, very distinctly convex along its lateral posterior margins, and terminating dorsally in an obtuse point; preanal plate very coarsely granulose, broad, triangular; anal plates coarsely granulose reticulate, compressed behind; fifty-four segments in all; legs long and flattened.

Total length 153 millim., or about 6 inches; width of nuchal plate 9 millim., at centre of body 11 millim., of preanal segment 8 millim.

Apparently about equally common with the preceding species.

3. *Spirostreptus corculus*, sp. n.

Head testaceous, with the front of the clypeus and labium castaneous; antennæ reddish castaneous; a broad blackish band connecting the ocular plates; nuchal plate blackish brown, with whitish anterior margin; dorsal segments with a whitish central stripe, in front of which they are dark ochreous and behind it stramineous, excepting at the sides, where there is a broad diffused brown longitudinal band; along the centre of the dorsal region there is also a more defined blackish band; legs pale flesh-coloured.

Body long, smooth, polished, rather suddenly attenuated towards the anal extremity: head rather large, almost circular when viewed in front; clypeus expanded at the sides, truncated in front, without a central sutural line; antennæ with long cylindrical joints, much as in the preceding species; ocular plates cuneiform, but with convex anterior margin, next to which there are ten facets, whereas the posterior margin only numbers from seven to eight; nuchal plate scarcely narrower at the sides than in the dorsal region, and therefore terminating on each side in a regularly-arched lobe, which is obliquely striated and has an indented line in front; dorsal segments tumid behind the middle line, longitudinally striated at the sides; preanal segment carinated along the posterior margin, oblique at the sides, and very slightly convex, terminating in a rather obtuse angle; subanal plate narrow, elongate-triangular, indented in front; anal plates compressed along the dorsal and posterior margins; fifty-six segments in all; legs rather long and slender, slightly compressed.

Total length 26 millim., or about 1 inch; width of nuchal plate 2 millim., at centre of body $2\frac{1}{4}$ millim., of preanal segment $1\frac{1}{2}$ millim.

Fairly numerous, but not so much so as the two larger species.

Dr. Karsch describes a species of *Spirostreptus* from N.E. Madagascar in the 'Zeitschrift für die gesammten Naturwissenschaften' for last year (p. 48), under the name of *Spirostreptus* (*Nodopyge*) *alligans*; and, notwithstanding the brevity and imperfection of the description, which even fails to give measurements, I am satisfied of its distinctness from any of the species here described.

MISCELLANEOUS.

The Genus Carterella *versus* Spongiophaga Pottsi.

Mr. Edward Potts referred to a paper ("On *Spongiophaga Pottsi*, n. sp.," Ann. and Mag. of Nat. Hist., Nov. 1881) by H. J. Carter,

F.R.S., &c., in which that eminent scientist gives an interpretation, differing from his own, of the statosphere tendrils which form the characteristic feature of the new genus of freshwater sponges to which Mr. Carter's name had been attached in recognition of his very distinguished services. He wished to consider the subject entirely apart from its personal relation to themselves, and only as it concerned the stability of a genus, in which, as he claimed, for the first time in the history of freshwater sponges, these tendrils had been noticed as distinctive features.

He then, at some length, gave his reasons why we should not accept Mr. Carter's theory of the parasitic nature of these tendrils or filaments, saying that of the two points in the paper most likely to impress a student who had not seen specimens of the genus referred to, or one unfamiliar with the general subject, the *first* was founded upon certain appearances represented in figure 2 of Mr. Carter's plate. This figure shows an "axial canal" through the centre of the filament, widening into the "tubular prolongation from the process of the chitinous coat" of the statosphere and representing the supposable digestive tract of the animal parasite.

As after repeated and very careful examination of numer us specimens, both in a fresh condition and after being subjected to different methods of preparation, he had failed entirely to meet with an instance showing similar appearances, he referred specimens of all three species of the genus to Prof. Jos. Leidy, whose fame as an accurate observer is world-wide; to Mr. Jno. A. Ryder, and to Prof. Kellicott and Mr. Henry Mills of Buffalo, the discoverers of one of the above species. The efforts of these gentlemen were equally unsuccessful, their opinion being well expressed in Prof. Leidy's words, "In my mind there can be no question as to the tendrils being part of the structure of the statoblast; and their parasitic nature would never have occurred to me." "The tendrils are homogeneous extensions of the inner capsule of the statoblast; and I see no trace of the appearance to which you refer in Carter's figure 2." A paragraph from the letter of Prof. Kellicott makes a further point. These processes "are not found on the statoblasts of any other species in the Niagara river; I have examined hundreds of the statoblasts of *Carterella tubisperma*, and have not found one without said tube. I brought some of these, having wintered in the river, to my room last May; after a few days, there was sponge-growth; so this form, if a parasite, did not destroy the life, &c."

The *second* point made by Mr. Carter was that the species marked *C. tubisperma* from Buffalo was identical, as shown by its spiculation, with one marked *Heteromeyenia repens* from Lehigh Gap, Pa. That one of these identical species should exhibit the tubular prolongation and accompanying tendrils, while the other did not, was considered presumptive evidence that the former was affected in some abnormal way. To this Mr. Potts answered, that while there was unquestionably much similarity in shape of the birotulate spicules of the two sponges, covering the "seed-bodies" in the ordinary fashion as a second or outer coat, the Lehigh-Gap species alone exhibited the second class of long birotulates, interspersed

with the others, which had induced him to place it in the genus *Heteromeyenia.* For this reason he believed the species were not identical, and this argument fails.

In continuation he reasoned that it should not be considered a matter of surprise that the statospheres of some genera pertaining to the family of freshwater sponges should present tentative features of this character. In a paper published so long ago as 1859, Mr. Carter called attention to the resemblance in appearance and function between the statoblasts of the Polyzoa and the so-called "seed-bodies" of *Spongilla.* The parallelism is rendered more complete when we observe that in those forms of Polyzoa possessing a comparativ ly rigid ectocyst, the statoblosts are circular or lenticular with smooth margins. Some of these are no doubt washed out from the tubular body from time to time during the winter, to extend the species to other places; while enough are retained by it to renew the growth in the original locality. On the other hand, where the body-mass is simply gelatinous, as in *Pectinatella*, *Cristatella*, &c., decaying away and releasing the statoblasts on the first approach of winter, these are provided with either a single row or a more complicated series of marginal tentacular hooks, by which they become matted together, entangled with roots, stems, &c., or held to rough places on planks or stones.

The same relation to the permanency of their skeleton structure we find existing amongst these genera and species of freshwater sponges. The statospheres of nearly all species are provided with some arrangement for protection and retention. These vary greatly in kind and degree, inversely according to the protection afforded them by the surrounding skeleton. Perhaps the lowest in the series in this regard is *Meyenia Leidyi.* This is a thin incrusting sponge, the skeleton-spicula stout and firmly matted together, maintaining the position of the form and the mass throughout the year. The statospheres are formed in the autumn, in the lowest parts of the sponge, within special capsules formed by interlacing spicula. It is hardly possible these should wash away; and accordingly we find no means provided peculiar to themselves for detaining them. Their armour consists of a closely laid series of birotulate spicula with entire margins, excellent as a shield, but hopelessly useless as a means of retention. On the other hand no apparent means of diffusion are provided; and as a consequence the species seems to be extremely local, none having been noticed except in the stream where the first specimen was gathered, and within a few yards of the probable spot.

Spongilla fragilis of Leidy, when seen during the summer-time, nearly resembles in form the above-mentioned species; its skeleton-structure, however, is much more fragile, and is frequently detached and washed away, leaving a uniform series of statoblasts standing side by side, with no special coating of spicules for each, as in most other species, but grouped and held together by a common coating of cellular or granular matter, covered by and imbedding a great number of cylindrical spined spicules. A variety of this is often observed (whether it differs specifically in other respects he could

not be certain) in which the statospheres are segregated into groups of four or more, spherically enclosed in a similar coating, thus appearing like one large seed. While the statoblasts of the former arrangement retain their positions during the winter and germinate there in the spring, it may be that *this* is a character assumed for diffusive propagation.

In *Spongilla lacustris* and similar branching sponges, the apparently conflicting ends of retention and diffusion are attained in a different way. The "seed" are formed in the interstices of both the sessile and the branching portions. In the former they are retained during the winter, partially by the agency of recurved spines upon the acerates projecting from the seed-coat; while the fragile branches soon break off and float their contained statospheres to distant parts.

The massive sessile character of many sponges, repeated through various forms of *Spongilla* and *Meyenia*, partially protects their statospheres from the accidents of the winter season; and when that protection fails them, the rays of the birotulate spicules of the latter and the curved acerates of the former come in play to retain a sufficient number until the time of germination in the spring.

Three species of American sponges have been grouped under the generic name *Heteromeyenia*, characterized by the presence of a *second* form of birotulate spicules interspersed amongst the more familiar series. These are about double the length of the former, and are terminated by long recurved hooks. The framework of two of these species is altogether filmy and fugitive; the statospheres are not held within the interspaces of the skeleton or retained in any other way, and are therefore dependent upon the above hooks for their attachment to proper bases for future growth.

Completing the series of retentive agencies, we find the statospheres of the three species of the disputed genus *Carterella* provided, in addition to their birotulate spicules, with long curling or twisting tendrils, extensions, as we have heard, of the tough chitinous coat. These are required to meet the emergency occasioned by the looseness of their skeleton-texture, from which the sarcode-flesh dying early washes away, most of the spicules soon following in the winter floods. The eggs are thus left to the protection of the above tendrils, which lap them together, bind them to the remaining spicules or the roots of water-weeds or shore-plants; or, assuming the rôle of the hair the plasterer uses, bind the deposited silt about them and both to the stones, where they await the appointed time for a new growth. This function is very clearly shown in the collection in Mr. Potts's possession; and the resemblance in material structure of these tendrils to that of the specialized hooks of the forms of Polyzoa referred to is very striking. He hopes therefore that, as both analogy and observed facts seem to indicate the correctness of his position, Mr. Carter will be willing to accept the compliment intended and which is so well deserved.—*Proc. Acad. Nat. Sci. Philad.*, Dec. 6, 1881.

Atlantic Actiniaria of the Dredgings of the Despatch-boat 'Le Travailleur.' By M. A. F. Marion.

The Actiniaria met with in the Bay of Biscay by the Commission of the 'Travailleur' may be referred to seven species, of which six are new to science; these are *Chitonactis Richardi*, nov. sp., *Gephyra Dohrnii*, v. Koch, var. *vasconica*, *Edwardsia flaccida*, nov. sp., *Edwardsia scabra*, nov. sp., *Edwardsia rigida*, nov. sp., *Palythoa glomerata*, nov. sp., and *Palythoa eupaguri*, nov. sp.

The animals evidently cannot, in the present state of our knowledge, serve clearly any considerations of zoological geography. We should show, however, that amongst them the only known type (*Gephyra Dohrnii*) belongs to the Mediterranean fauna. But the true physiognomy of the Cœlenterata of the Bay of Biscay cannot be shown until we join to the Actiniaria of this region the Corals and the Alcyonaria, which present, besides several undescribed forms, some Mediterranean and Mexican species.

It should, in the first place, be remarked how important is the position occupied in our list by the genus *Edwardsia*. Moseley has already found one species (*Edwardsia coriacea*) near Cape St. Vincent, at a depth of 600 fathoms. Our *Edwardsia flaccida* was represented by numerous individuals, and at various stations, from 600 to 1160 metres. *Edwardsia scabra* and *E. rigida* also descend to 1100 metres. However, these species do not differ in organization from those which frequent the coasts. They have not more than eight cells, though their tentacles may be more numerous, as if recalling one of the most interesting stages in the embryogeny of the Actiniaria.

Their histology falls under the ordinary plan of structure; but some external morphological peculiarities very distinctly characterize our three species.

In *Edwardsia flaccida* the rugose portion of the column is of a bright brownish-yellow tint. It is traversed by eight furrows, corresponding to the septa. The foot-region may protrude in a transparent ampulla. The upper portion of the column is smooth and of a deep carmine colour. The tentacles are ten in number.

Edwardsia scabra is likewise furrowed, but is distinguished by the tuberosities of its column. *Edwardsia rigida* is of a characteristic brown tint, and possesses peculiar mesodermic projections.

The *Palythoæ* have already long been known from great depths. *Palythoa glomerata* forms polypidoms in incrusting layers upon the radioles of *Cidaris*, on corals, and on *Isis*. *Palythoa eupaguri* lives in curious commensalism with a new species of *Eupagurus* *, towards which it plays the part of *Adamsia palliata*, always associated with *Eupagurus Prideauxii*.

Gephyra Dohrnii of the Bay of Biscay is more brilliant in colour than the Mediterranean individuals; it is also a little larger. We have observed it only in isolated cases upon the stems of *Isis*. We consider it to be an Atlantic race. It is undoubtedly alongside of this type, and consequently in the vicinity of *Paractis*, that we must

* *Eupagurus Jacobi*, A. Milne-Edwards.

range *Actinia abyssicola* and *A. gelatinosa*, found by Moseley at Amboina and at the Bermudas upon the deep-sea Isididæ.

Chitonactis Richardi must be reckoned amongst the largest of Actiniidæ, and finds its place in the family Bunodidæ. This genus, erected by Fischer, is characterized by its false epidermis, so that it is to the true *Bunodes* what *Phellia* is to *Sagartia*. The histological structure of *Chitonactis*, however, is very distinct from that of *Bunodes*. The ectoderm is formed of slender fusiform cells closely resembling one another. The column being thick and coriaceous, the mesoderm acquires a great development, and presents at its centre very numerous patches of annular muscular bundles identical with those of *Calliactis effœta*. The existence of so peculiar a histological conformation in these two Actiniidæ, perfectly distinct in other respects, evidently corresponds to the rigidity of the column, in which contraction cannot be effected except by bringing into play a mesodermal muscular system, represented, doubtless in a rudimentary manner, in several types, but offering here its maximum development.

Chitonactis Richardi has been met with in two totally different conditions, the influence of which has been sufficient to produce two very remarkable races. One is represented by large specimens fastened upon the branches of *Mopsea elongata*. The column is almost perfectly smooth ; and the cuticular deposits exist only upon the tubercles. The foot grasps the branches of the Isidian by extending tonguelets, or by folding over in two large lips. The other race includes rather smaller individuals, found rather nearer to the coast, and at a depth of only 306 metres. Their columns are entirely covered by cuticular lamellæ. These *Chitonactines* attach themselves directly to the sandy mud, in such a manner that the foot, not finding sufficient resistance, buries itself, producing an immense ampulla which resembles the extremity of the body of certain errant Actiniaria.

Thus this small collection of malacodermous Zoantharia possesses real interest. It merits special notice the more as the deep-sea species are still very little known. It is sufficient now to remark that Moseley has described only six abyssal forms at the termination of the prolonged expedition of the 'Challenger.'—*Comptes Rendus*, February 13, 1882, p. 458.

Colour in Autumn Leaves.

Mr. Thomas Meehan referred to an excursion to the Salt Marshes of New Jersey, organized by a member of the Academy, Mr. Isaac C. Martindale, and generously seconded by the Camden and Atlantic Railroad Company, which furnished a special train of twelve cars for the company, with the privilege of stopping along the road at interesting botanical points. This gave unusual opportunity to examine the vegetation of the Salt Marshes, which at this season of the year presented a scene of coloured beauty unequalled perhaps in the whole world.

Mr. Meehan remarked that the vegetation which for the most part made up this flora was either precisely the same as those which

entered into the flora of similar localities in Western Europe, or else of species so closely allied that only critical examination would show the distinction. The plant which gave the greatest brilliancy, chiefly on account of its numerical proportions, was *Salicornia herbacea*, the same plant which abounds along European shores. To the rich rosy red of this species *Salicornia mucronata* (of Bigelow, *S. virginica* of most authors) added a rosy brown. Although this species is American, there are forms of *S. herbacea* on the English coast which approach it. The third species is *S. ambigua* of Michaux, a perennial species and the analogue of the British *S. radicans*. This one never changes its bright green colour till severe frost destroys it. The lively green very much enlivens the brilliancy of the orange, red, and brown in the other marsh-plants. The species precisely the same with those of England which gave colour to the marshes, besides these Salicornias, were *Salsola Kali*, *Suæda maritima*, *Atriplex patula*, *Polygonum maritimum*, *Spartina stricta*, *Spartina juncea*, and *Ammophila arenaria*—the three last, grasses which add much by their light browns to the richness of the whole. *Statice limonium*, by its faded blue-grey tint, gave a peculiar element to the colour. *Aster flexuosus*, closely related to *Aster trifolium* of European marshes, furnished a tint of purple-green. So far as could be observed of the many other species of plants which might be collected, these were the only ones giving character to the beautifully coloured picture the marshes presented at this time.

The most interesting inquiry here presents itself—Why should plants common in the main to both continents, colour so much more brightly in America than in Europe? We are reminded that what we see here in these marsh-plants does not hold good with close allies in other species. Among trees and shrubs there are some peculiar to each country, but closely allied, in which all the American allies colour, while the European rarely do. He named on the American side, *Betula populifolia*, *Fraxinus sambucifolia*, *Quercus alba*, *Cratægus cordata*, *Ulmus americana*, *Alnus serrulata*, *Castanea americana*, as against *Betula alba*, *Fraxinus excelsior*, *Quercus robur*, *Cratægus oxyacantha*, *Ulmus campestris*, *Alnus glutinosa*, and *Castanea vesca*. The whole American line had autumn colouring, of which the parallel European line was wholly destitute. These trees did not lose this characteristic by removal to the other continent. In America there were many of the European species five or ten generations from seed; and yet these last generations showed no more disposition to embrace the colour-characteristics of their American cousins than did the first progenitor brought from abroad. We were so accustomed to associate our bright clear autumn skies with the colour of our autumn foliage, that facts like these stagger us. Why should several generations of these European trees resist our climatal influences? But we have to remember that the colouring of fruits and foliage is not wholly the result of chemical power; what for want of a better name we know as vital power, claims a share.

Some apples have colour on the sunny side, while the rosy cheek never appears on those of the same variety hidden by the foliage;

and in these cases it is self-evident that sunlight is a cause of colour. Yet if we pluck such a variety from the tree, and place it in the sunlight, it will not colour; so that we see here that there must be a connexion with the living principle in the tree to enable the solar rays to act. Yet it requires a relaxation of the leaf's hold on life to bring out these colours. At any time during the summer a maturing leaf on an American tree exhibits bright colour; yet if a dying leaf, half-coloured, be plucked from the parent stem, there is no further change in the tint. Many leaves pass through grades, as green, light yellow, orange-brown to scarlet. If they are gathered at yellow or brown they remain yellow or brown, and so on all through these stages. Colouring, therefore, could not wholly be considered chemically; for though decay, which we take to be a chemical action, is going on during the colouring stage, complete separation from the living tree at once stops the process.

If we consider these two facts together, and then some other known natural laws, we may form some reasonable hypothesis. There is, for instance, the principle of heredity, so ably insisted on by Mr. Darwin, in connexion with all living things. A force once applied to an object exerts an influence after the power has been removed. A wheel runs round after the hand which turns it is taken away; and a change in a plant brought about by any circumstance will continue in connexion with that plant some generations after the circumstances have ceased to exist. That this is so has been proved by Naudin with hybrid (or perhaps we should say crossed) lettuces, and in other ways. Supposing, then, these closely allied species to have been originally of one parentage, how did the power in one case to change to bright colour, or in the other to resist the tendency to colour, originate? If by chemical power alone, it would occur at once, as a piece of white wood is at once browned by fire; but with the vital principle opposed to this chemically destructive principle, it would take more time to accomplish this change, and, the change once made, would again require more time to again alter the fixed condition. This is essentially the foundation of the law of heredity; and under its operation we could not reasonably look for a change in the colouring-power of these European trees, although light were an active agent, under even more than five or ten inheriting generations.

At any rate we have in these salt-marsh plants the evidence that the plants of one country, in that country colourless, can be made to take the most brilliant colours when growing in ours. That these plants had one primary origin is certain, though the ancestry may have been separated by thousands of years. We know that plants introduced at once do not change at once; heredity forbids it. We may assume, therefore, that it was only after some generations on the American coast, under the influence perhaps of American light, that these European plants showed their American colours. We can see in these annual plants, with a new generation every year, the results in numerous generations, as we cannot see in the more slowly reproducing tree.

Mr. Meehan thought that though we could not say we had yet reached an unchallengeable solution of the cause of autumn colour in American foliage, considerations like these brought us nearer to the end.—*Proc. Acad. Nat. Sci. Philad.*, Nov. 1, 1881.

Centrolophus pompilus.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—In your issue for this month Dr. Günther, when alluding to the capture of a Blackfish (*Centrolophus pompilus*) at the mouth of the Colne, observes that, so far as he is aware, "this is the first instance known of the fish having wandered so far eastwards."

In 1841, one 14 inches in length was taken at Lossiemouth; in 1850 Mr. Alder remarked on one captured at Cullercoats, in Northumberland; while in the 'Zoologist,' 1852 (p. 3504), Mr. Rudd mentions one obtained at Redcar, in Yorkshire.

Yours truly,
Francis Day.

P.S. The same example was recorded by Mr. Laver in the 'Zoologist,' 1882, p. 75.

Cheltenham, March 4, 1882.

On a Fœtal Kangaroo and its Membranes. By Henry C. Chapman, M.D.

Since the publication, nearly fifty years ago, of Prof. Owen's invaluable paper* "On the Generation of the Marsupial Animals," in which the fœtal Kangaroo and membranes were first described, no further contribution has been made to our knowledge of this very important subject. Indeed some naturalists at the present day seem indisposed to accept Prof. Owen's statement that there is no connexion in the Kangaroo between the fœtal membrane and the uterus, or, in other words, that no placenta is developed, and therefore doubt that the division of the Mammalia into non-placental and placental is not a valid one. Even though the present communication should not contain any thing particularly new, I trust, however, that it will not be received without interest, if for no other reason than that it confirms essentially Prof. Owen's descriptions.

One would have naturally supposed that, during the past half century, among all the Kangaroos killed in Australia and opened in various zoological gardens, at least one fœtal Kangaroo would have been found. As a matter of fact, however, this does not appear to have been the case; or, at least, if such was found, no record was made of it. Impressed with this fact, I never failed to examine the generative apparatus in the female Kangaroos which died from time to time in the Philadelphia Zoological Garden, with the hope that I might obtain an embryo. In September 1879 I was successful, finding the specimen which forms the subject of the

* Phil. Trans. 1834.

present communication, and to which I incidentally alluded in a previous communication to the Academy *.

The female Kangaroo in which I found the embryo was a fine example of the *Macropus giganteus*, and had taken the male about fourteen days before its death, which was caused by injuries inflicted upon itself, due to a fright incident to the boxing the animal for shipment. The embryo was therefore not more than fourteen days old. On opening the uterus of the left side, which was considerably swollen, the embryo Kangaroo was seen through the transparent chorion. The chorion, which was thickened in places, insinuated itself between the folds into which the lining membrane of the uterus was thrown. The chorion, however, was entirely free from villi or villous processes of any kind, and was perfectly separable in its entire extent from the uterine surface; indeed it was readily turned out of the uterus intact. On opening the chorion, the embryo Kangaroo was seen enclosed in a very delicate amnion, which was easily lacerated. What at once struck me, on opening the chorion, was the large size of the umbilical vesicle and the undeveloped condition of the allantois, which, though small, was undoubtedly present, consisting of a pear-shaped vesicle or diverticulum from the posterior part of the intestine. The umbilical vesicle adhered to the chorion by that part of its surface most remote from the umbilicus, the line of demarcation between chorion and umbilical vesicle being indicated by a circular blood-vessel. When in the fresh condition, the umbilical vesicle was seen to be highly vascular. The blood-vessels that ramified over its surface consisted of two veins and an artery. The veins began as one vessel from the under surface of the liver, which diverged at the umbilicus and united again on the umbilical vesicle as a terminal or marginal vein, *i. e.* the circular vein just referred to and which indicated the line of contact of the umbilical vesicle with the chorion. The third vessel was an artery, and through the mesenteric could be traced to the aorta. These vessels evidently correspond to the omphalo-mesenteric or vitelline veins and arteries of other vertebrate embryos as seen, for example, in the embryo chick. The disposition of the umbilical vesicle with reference to the chorion (its large size and vascularity) reminded me also very much of the rabbit or rodent type of development. While, as we have just seen, the umbilical vesicle was in contact with the chorion, the rudimentary allantois, on the contrary, hung freely by its pedicle or urachus in the space between the amnion, the stem of the umbilical vesicle, and the chorion.

When the allantois was first examined, there could be distinctly seen three very fine vessels, two of which appeared to come from the aorta and corresponded therefore to the umbilical or hypogastric arteries of the placental mammals, while the remaining vessel I considered to represent the umbilical vein of the same. The small size of the allantois and the rudimentary condition of its blood-

* "Placenta of the Elephant," Journal of Phil. Acad. vol. viii. p. 5.

vessels, taken in connexion with the length of the embryo and the short time that the latter remains in the uterus, makes it impossible for me to think that in the Kangaroo a placenta is ever developed. I use the word placenta in the sense ordinarily accepted, meaning a structure which consists of the interlacing of the allantoic blood-vessels with those of the decidua serotina of the uterus—that is, of that part of the hypertrophied mucous membrane of the uterus in contact with the ovum. Further, while the umbilical vessel is fused through part of this surface with the chorion, the chorion is only in contact with the inner surface of the uterus, not adhering to it in any way. The disposition of these membranes in the Kangaroo embryo is therefore different from the so-called placenta of certain Sharks, which consists in the interlacing of the omphalo-mesenteric blood-vessels with those of the uterus. This structure in the Sharks, though called a placenta, is not homologous with the mammalian placenta, this consisting, as we have seen, of the allantoic vessels and those of the uterus. The Kangaroo cannot be said, therefore, to have a placenta in either sense in which that word is used. The small size of the embryo Kangaroo at birth would lead me to suppose that it drew its nourishment from the umbilical vesicle like the reptile or bird, rather than from the uterine walls as in the mammal. If the uterus does contribute to the nourishment of the fœtal Kangaroo, such nutriment must osmose through the omphalo-mesenteric vessels. The contact of the chorion with the uterus, however, is of a very adventitious character. The embryo Kangaroo itself measured six eighths of an inch in length from the mouth to the root of the tail. The latter was one eighth of an inch long. The mouth was open; and the tongue, though large, was not protruded. The palpebral folds were not developed. There was no sign of an auricle. Four branchial clefts could be distinguished. The anterior extremities were well developed; but the digits had not appeared. The posterior extremities were represented only by small buds, not very apparent except with a lens. Indications of the ribs were distinctly visible. The membranous spinal cord could be seen, the elements of the vertebræ being as yet ununited. A penis was visible just in front of the anus. On the supposition that the theory of evolution is true, one would naturally expect to find forms intermediate in their structure and development between the reptiles and birds on the one hand and the placental mammalia on the other. As is well known, in the structure of its skeleton and generative apparatus, the *Ornithorhynchus* resembles very closely the reptile and bird, while, as we have just seen, the fœtal membranes of the Kangaroo recall the corresponding parts in the reptilian-bird type and foreshadow those of the placental mammal. If the parts in question have been truthfully described and correctly interpreted as partly bridging over the gap between the non-placental and placental vertebrates, they supply exactly what the theory of evolution demands, and furnish, therefore, one more proof of the truth of that doctrine.—*Proc. Acad. Nat. Sci. Philad.*, Dec. 27, 1881.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 53. MAY 1882.

XXXIV.—*Notes on the Structure and Development of* Siphonaria australis, *Quoy & Gaimard.* By Professor F. W. Hutton, of Canterbury College, New Zealand.

[Plate XV.]

The only account of the structure of *Siphonaria* that I have been able to see is that given by MM. Quoy and Gaimard in the Zoology of the Voyage of the 'Astrolabe.' These naturalists showed that *Siphonaria* was a pulmonate Gastropod with a gill in its respiratory chamber; and they described the alimentary and reproductive organs; but as, at the time they wrote, the latter organs in the pulmonates were not understood, they did not interpret the different parts quite correctly.

Siphonaria australis is common in Lyttelton Harbour; and I have made some observations on its structure and development which appear to me to be of sufficient interest to warrant their publication; a list of the New-Zealand species, with descriptions of their dentition, will be submitted to the New-Zealand Institute.

Alimentary System (Plate XV. fig. 1).—The buccal mass is reddish purple; the salivary glands, which are large and white, open into it, and not into the œsophagus, as stated by MM. Quoy and Gaimard. The œsophagus is short, and gradually expands into the wide and longitudinally plicated

stomach, which is of a yellowish-white colour. The liver is large and pale yellow; the hepatic ducts open into the fundus of the stomach. The intestine leaves the stomach abruptly on the left side, and passes straight forward to the heart; after passing round the aorta, it crosses obliquely backward over the stomach to the right; after making another short bend forward and to the left, it bends once more backward and to the left, descends as far as the end of the stomach, and then passes straight to the anus, which lies in the lobe of the pulmonary opening. Numerous particles of calcite are scattered about the various organs.

Reproductive System (figs. 2 and 7).—The ovo-testis is rounded, like that of *Limax*, and of a brownish-yellow colour; the hermaphrodite duct is rather short and blackish. The albumen-gland is short and of a pale yellow colour, like the swollen portion of the oviduct. The spermatheca is brownish or purplish, oval in shape, and with a long stalk. The vas deferens leaves the oviduct near the anterior end of the swollen portion. The oviduct is suddenly narrowed; and this narrowest portion, together with the vas deferens and the stalk of the spermatheca, penetrate into the musculature of the foot; they then turn sharply forward, and open with the penis in a common genital opening on the right side of the head. The penis is narrow and curved, and has a large pale yellow gland for the secretion of the spermatophore. The spermatophores (fig. 7) are long and cylindrical, rounded at one end, and rather suddenly narrowed into a long tail at the other. They are quite smooth.

The *renal organ* (figs. 3 and 4, *d*) is double, one half being attached to the lower, the other to the upper wall of the respiratory chamber, in such a position that the one half lies over the other. It lies on the left side of the animal; and immediately at its apex is situated the heart.

Transversely across the animal, from the renal organ to the respiratory opening, lie the *gills* (figs. 3 and 4, *e*). There are two of them, attached, like the renal organ, to the upper and lower surfaces of the respiratory chamber; but the lower one is very feebly developed. These gills are not free, but are merely folds of the integument crossing between two large vessels in the walls of the respiratory chamber. Evidently they are adaptive in origin, and not homologous with the gills of other Mollusca. The interior of the respiratory chamber, and the gills, are richly ciliated; and the animal seems to respire air and water indifferently. The respiratory orifice is often seen open, both in the air and under water; but in the latter case the lobe below the opening is generally raised,

so as to divide it into inhalant and exhalant openings (see fig. 5).

The experiments of the Rev. J. Tenison-Woods, described in the 'Transactions of the Royal Society of Tasmania' for 1876, p. 54, appear to corroborate this view. In the aquarium the animal always leaves the water, like *Littorina*; it would seem therefore to prefer breathing air.

Nervous System (fig. 6).—The cephalic ganglia are small, and connected by a long and thin commissure; the optic nerves proceed from them as usual; but there are no eyes or tentacles. On this point I can confirm Mr. Tenison-Woods, notwithstanding that Quoy and Gaimard have figured the eyes. The pedal ganglia are moderately close; and each sends off two large nerves to the foot; otocysts are developed on these ganglia. The parieto-splanchnic ganglia are remarkable for being asymmetrical, both being on the right side; they send off nerves to the reproductive organs.

Development (figs. 8–12).—The eggs are enclosed in an elongated gelatinous mass attached by one side to rocks, in a more or less semicircular form. The eggs are ovoid, about ·007 inch in length, and joined to each other by a fine string. The embryo is at first spherical and ciliated, revolving rapidly in the egg. It then becomes constricted across the middle; and one of the halves develops stronger cilia, becomes bilobed, and forms a well-developed velum. The other half becomes invested with a nautiloid shell. Two otocysts are developed; the foot grows out below the velum; and an operculum is formed on its posterior end. A retractor muscle arises from the periphery of the shell on the left side, and, passing above the body, is inserted in the foot. By means of this muscle the animal can be completely withdrawn into the shell, which is then closed by the operculum. In this state the young animal leaves the egg, and makes its way through the now softened jelly by vigorous use of the velum. Once in the water, the animal swims away rapidly; and after some time the shell falls off, the operculum still remaining on the foot. The jelly seems to be softened by the attacks of Infusoria. I have not been able to trace the development further.

These observations were made on ova laid by *Siphonaria australis* in an aquarium; and there is no doubt as to the species to which they belong. They show that it is a true pulmonate, and that the gill does not indicate an intermediate form between Pulmonata and Branchiata. They also show that the Pulmonata have been derived from operculated branchiate mollusks with a curled shell.

In their reproductive organs and in their dentition the

Pulmonates approach much more nearly to the Opisthobranchs than they do to the Prosobranchs; we must therefore suppose that they are derived from the former; and it seems to me that there are more reasons for uniting the Opisthobranchs with the Pulmonates than with the Prosobranchs. The Gastropoda would thus be divided into two subclasses. The monœcious Gastropods (*Gastropoda monæca*) would contain the two orders Pulmonata and Opisthobranchiata, while the diœcious Gastropods (*Gastropoda diæca*) would contain the two orders Prosobranchiata and Heteropoda.

EXPLANATION OF PLATE XV.

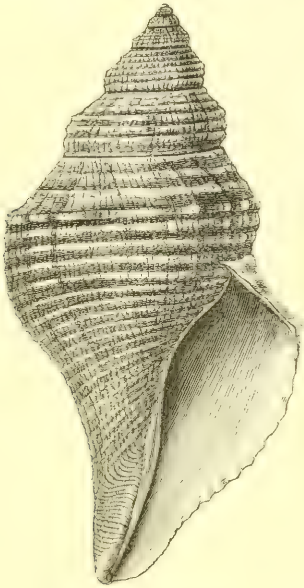
Fig. 1. *Siphonaria australis*: alimentary system, × 3. *a*, buccal mass; *b*, salivary glands; *c*, odontophore; *d*, heart; *e*, stomach; *f*, intestine; *g*, liver; *h*, rectum.
Fig. 2. Reproductive system, × 3. *a*, penis; *b*, vas deferens; *c*, gland; *d*, ovo-testis; *e*, hermaphrodite duct; *f*, swollen portion of oviduct; *g*, albumen-gland; *h*, narrow portion of oviduct; *i*, spermatheca; *k*, rectum.
Fig. 3. Animal with the respiratory cavity laid open, × 2. *a*, head; *b*, anus; *c*, heart; *d*, renal organ; *e*, gill.
Fig. 4. Portion of gill and half the renal organ, × 10. *d*, renal organ; *e*, gill.
Fig. 5. Animal seen from below, × 2. *a*, foot; *b*, head; *c*, respiratory opening and lobe; *d*, mantle.
Fig. 6. Nervous system, × 6. *a*, cephalic ganglion; *b*, pedal ganglion; *c*, parieto-splanchnic ganglia; *d*, reproductive orifice.
Fig. 7. Spermatophore, × 12.
Fig. 8. Mass of ova, nat. size.
Fig. 9. Ovum with embryo, × 160.
Fig. 10. Ovum with embryo further advanced, × 160.
Fig. 11. Veliger of *Siphonaria australis*, × 160. *a*, velum; *b*, otocyst; *c*, foot; *d*, operculum; *e*, shell; *f*, retractor muscle.
Fig. 12. Embryonic shell of *Siphonaria australis*, × 160.

XXXV.—*Description of a Species of* Fusus. By Edgar A. Smith.

Fusus corpulentus.

Shell large, ponderous, fusiform, uniformly light yellowish brown, strongly spirally costate, striated and sulcate, longitudinally grooved on the upper whorls, and marked with strong lines of growth on the rest of the surface. Volutions about nine, sloping and very slightly concave at the upper half, convex below the middle, and somewhat constricted at the base; thickened above, just below the suture. Spiral ridges

six in number on the upper whorls, about as broad as the sulci between them, about twenty-four on the last, with fine striæ in the interstices. Those on the first six whorls subgranular through being crossed by coarse longitudinal sulci, which produce a clathrated surface. As the shell increases, these sulci gradually diminish and become merely coarse striæ or lines of growth. On the last and penultimate whorls the fourth spiral ridge from the top is tubercular, the tubercles gradually increasing in prominence as the lip is approached.



Half natural size.

At the tubercles (about twelve in number on the body-whorl) the shell is somewhat longitudinally plicate. Last whorl decidedly concave above, a little angular at the tubercular ridge, convex beneath it, gradually narrowing into a rather short cauda. Aperture elongate, narrow, together with the short, wide, oblique, and slightly recurved canal occupying almost three fifths of the entire length of the shell, yellowish and rosy white within. Columella gently arcuate at the upper part, oblique and straightish below the middle, of the same colour as the aperture, with only a very thin deposit of callus at the upper part. Outer lip not thickened, wavy at the edge, shallowly grooved within, the grooves corresponding to the ridges of the exterior.

Length $6\frac{1}{4}$ inches, greatest diameter $3\frac{1}{6}$; aperture with the canal $3\frac{5}{8}$ long, $1\frac{1}{4}$ wide.

Hab. —— ?

This species has lately been purchased by the British Museum, and, although of large size, is apparently undescribed. It is a ponderous shell, in form not unlike certain species of the genus *Fasciolaria*, and well distinguished by the character of its sculpture. The uppermost of the spiral ridges forms the thickening beneath the sutural line; and the two beneath are a little finer than the three others upon the lower convex half of the whorls.

XXXVI.—*Some Sponges from the West Indies and Acapulco in the Liverpool Free Museum described, with general and classificatory Remarks.* By H. J. Carter, F.R.S. &c.

[Plates XI. & XII.]

[Concluded from p. 301.]

Family 2. **Suberitida.**

Group Laxa.

Cliona caribbœa, n. sp.

Sponge excavating; appearing on the surface of old coral (*Porites*) in irregularly scattered subcircular holes, varying in size under a quarter of an inch in diameter, which communicate through short channels with cavernous ragged excavations interiorly; channels filled with tubular processes of the sponge, open and marginated at the holes or closed by a perforated diaphragm, communicating internally with the sponge, which tapestries the cavernous excavations. Texture loose. Colour ochraceous yellow. Vents represented by the open holes; pore-area by the diaphragms. Spicules of two forms, viz.:—1, skeletal, pin-like, smooth, curved, consisting of a spherical head followed by a constriction and then a fusiform shaft, about as wide in the thickest part as the head, gradually terminating in a sharp point, length about 95 by $2\frac{1}{2}$-6000ths of an inch (Pl. XII. fig. 26, *a*); 2, flesh-spicule, a spinispirula, extremely slender, about 7-6000ths inch long, presenting five or six bends (fig. 26, *b*, *c*). Size of specimen indefinite and undeterminable, from the internal extent of the excavations being concealed.

Hab. Marine. Burrowing in hard calcareous objects.

Loc. Island of St. Vincent, West Indies.

Obs. The characters generally of this sponge are almost identical with those of our *Cliona celata*, when burrowing in calcareous objects; but the globular form of the head of the skeletal spicule, taken on an average, and the presence of the flesh-spicule cause it to differ. Whether or not *Cliona caribbæa* ever occurs in a *free* state analogous to *Rhaphyrus Griffithsii*, Bk., which is that taken by *C. celata* after having completely destroyed the oyster-shell in which it may have been burrowing, must be determined by further research.

General Observations.

Here it may be stated that, without mounting a microscopic frangment of this sponge in balsam, the flesh-spicules, from their extreme delicacy, would pass unnoticed; and such is the case with many other sponges of this kind, in which the minute size and crooked spinispirular form of the flesh-spicule render the latter difficult of detection until the sarcode is made clearer and more homogeneous by drying and subsequently mounting in Canada balsam. At the same time it must be remembered that the flesh-spicules are chiefly confined to the surface in many instances, and therefore may not be seen in a fragment from the interior, also that they do not exist in all these sponges; hence the necessity of determining these points in the way that I have mentioned.

The spinispirula in the Suberite sponges, by which is meant those in the groups Cavernosa, Compacta, and Laxa, was first noticed by Dr. Bowerbank in 1864 (Mon. Brit. Spong. vol. i. pl. iii. fig. 72), when, together with an unspined spirula (*ibid.* fig. 71), it was found inadvertently in *Halichondria sanguinea*, Johnst. (*ib.* p. 239), where he considered them to be of "extraneous" origin; but when we remember that no sponge, in texture and spiculation, is more suberitic, *i. e.* cork-like, than a dried *H. sanguinea*, the presence of such spicules there does not seem strange; but it is strange that the *identical* form of this spinispirula should be repeated eight years afterwards (Proc. Zool. Soc. 1872, pl. xlix. fig. 7) as the type spicule of a large free massive Suberite of an ochre-yellow colour from Madeira, called by Dr. Bowerbank "*Hymeniacidon angulata*," when one from the sponge itself, with the slightest difference (for there are no two spinispirulas exactly alike), would have been much more satisfactory.

In 1864 also, Schmidt gave a good figure of a spinispirula (Spong. Adriat. Meeres, 1st Suppl. Taf. iv. fig. 12) from a "corticate" sponge (Rindschwamm) from the island of Cyprus, but without any further notice.

Meanwhile Albany Hancock (in 1867) found, described, and figured the spinispirula in several "Excavating Sponges" ('Annals,' vol. xix. p. 229, pls. vii. and viii.).

Again, in 1878 Schmidt figured the spinispirula of a sponge which he described under the name of *Spirastrella cunctatrix* (Spong. Küste v. Algier, S. 17, Taf. iii. fig. 8), likening it to the one from Cyprus, and also that of *Tethya bistellata* (Spong. Adriat. Meeres, S. 45, Taf. vii. fig. 1); lastly, in 1870 he gave this form for the flesh-spicules of his *Chondrilla phyllodes* and *Vioa Johnstonii* respectively (Spong. Atlant. Gebietes, Taf. vi. figs. 1 and 18). Here it might be observed cursorily that, however much the stellate and spinispirular flesh-spicules may be but transitionary forms of one another, as stated by Schmidt (*op. cit.* S. 5), yet the same cannot be said of the acerate and pin-like spicules which respectively characterize his *Vioa Johnstonii* of 1862 (Spong. Adriat. Meeres, S. 78, Taf. vii. fig. 17) and that of 1870 (*l. c.*), albeit both are excavating sponges, and both possess the same beautiful carmine colour. But neither colour nor habit are always of much value in a specific point of view; for the Australian species, viz. *Alcyonium purpureum* of Lamarck, which is also a Suberite, and another Australian species in the Liverpool Free Museum, although equally carmine in colour, are different in spiculation, if not in habit also, from the presence of the spinispirula in the former with a fine structure, and the absence of it in the latter with a gritty one of adventitious matter. Hence I should be inclined to change the name of Schmidt's *Vioa Johnstonii* of 1862 to that of *Vioa Schmidtii*, which in the form of its skeleton-spicule, viz. an acerate, agrees with my *Rhaphidhistia spectabilis* of the Mauritius ('Annals,' 1879, vol. iii. pl. xxvi. figs. 13 and 14). The spinispirula, under various forms, is so often combined with a pin-like skeletal spicule, and the latter is so generally characteristic of the Suberite-sponges, that we cannot help connecting them with this kind of spiculation; at the same time it is not *always* the case, as the occurrence of an acerate form in the instances just mentioned proves. To be able to demonstrate a *corky* texture in sponges which hardly exceed a mere film in thickness, as in *Rhaphidhistia spectabilis*, which possesses the longest and most beautiful spinispirula that I have ever seen, is of course impossible; hence the spiculation alone here remains for guidance.

Having mounted fragments of many Suberites for the purpose of proving what I have above stated—that is, to see if they contained any flesh-spicule besides the pin-like skeletal one,—I will give a list of those that I myself have examined,

including such as have been found by others to present the spinispirula or any other form of flesh-spicule; in doing which, it will be best to divide them into the three groups mentioned in my Classification, viz. the Cavernosa, Compacta, and Laxa, typified respectively by *Rhaphyrus Griffithsii*, Bk.,=*Cliona celata*, Johnst. (the free form of an excavating sponge!), *Suberites domuncula*, Sdt.,=*Halichondria suberea*, Johnst., and *Cliona corallinoides*, Hancock. But to this I must now add a fourth group under the name of "Subcompacta," typified by *Suberites massa*, Sdt., because I find that it will be more convenient to limit the "Compacta" to the strictly compact forms, to keep the "Laxa" chiefly to the excavating Suberites, and to make the "Subcompacta" a group between the "Cavernosa" and "Compacta," since the coarser cellular structure of *Rhaphyrus Griffithsii*, *Rhaphiophora patera* (Neptune's cup), &c., which mostly have a grey or brown colour, cannot be so advantageously classed with the less coarse ones, which are chiefly of an ochraceous-yellow colour—all, however, having, like the "Cavernosa," that condensed structure on the surface which seems to have led Schmidt to place his *Spirastrella cunctatrix* among his "Corticatæ" ("Rindschwämme," Spong. Küste v. Algier, 1868, p. 17).

In giving this indication of the Suberites that I have examined (of course, all in the dried state) to see if they contain any flesh-spicule, it will also be desirable not only to catalogue them as above mentioned, but, in each group, to divide those which do *not* from those which *do* possess a flesh-spicule. Again, as the form of the spinispirula differs in different species, it will be desirable to add some note of this, in which the largest size is given respectively, remembering that they will be found in each instance in a fragmentary or less perfect state in all sizes below this. Lastly, as I shall have to introduce some hitherto undescribed species, it will be necessary, where possible, not only to name but to briefly characterize some of them at the same time.

List of Suberites with and without the flesh-spicule.

CAVERNOSA.

Without flesh-spicule.

Rhaphyrus Griffithsii, Bk.,=free form of *Cliona celata*.

Rhaphiophora patera, Gray (Neptune's cup).

With flesh-spicule.

Spongia Dysoni, Bk. This is the name on the largest specimen of this sponge in the British Museum, presented in 1862. =*Hymeniacidon pulvinatus*, Bk., on a small specimen of the same species presented in 1872. At Belize, the locality of this sponge, an enormous specimen is said to have been found growing on a rock which could not be touched with the oar of the boat; and hence its head alone was taken off for preservation. It is still undescribed; but there are many specimens of it in the British Museum under my running no. 457, the two largest of which are flat pieces, registered nos. 66. 5. 24. 12 and -13, labelled "*Spongia Dysoni*," the former in size $20 \times 25 \times 4\frac{1}{2}$, and the latter $33\frac{1}{2} \times 27\frac{1}{2} \times 8$ inches in their greatest dimensions.—*Character*. Massive, convex. Structure cellulo-cavernous. Colour in the dry state grey-violet. Surface smooth, remarkably irregular from its nodular projections, furnished plentifully with isolated cribriform patches of vent-holes, which open into the cellular cavities beneath. Skeletal spicule pin-like (Pl. XII. fig. 25, *a*); flesh-spicule a spinispirula with five bends about 4-6000ths inch long (fig. 25, *b*, *c*).

Suberites capensis, mihi, n. sp.—*Character*. Massive, cake-like, flat compressed, semicircular. Structure cellulo-cavernous. Colour brown externally. Surface uniformly rough, and compact on each side, loose on the margin, which is semicircular and an inch thick, where the vents, which are large and numerous, are situated, Pandean-pipe-like. Skeleton-spicule pin-like; flesh-spicule a spinispirula with four bends about 5-6000ths inch long. In the British Museum labelled "Port Elizabeth," running no. 10, registered no. 71. 6. 5. 1. Size $14\frac{1}{2} \times 5\frac{1}{2}$ inches by 1 inch thick.

Subcompacta.

Without flesh-spicule.

Suberites antarcticus, mihi. British Museum, running no. 405, registered 44. 4. ? . ?. Dredged by Sir James Ross in $74\frac{1}{2}°$ S. lat., in 206 fathoms (Expedition of 1841), undescribed. *Character*. Stipitate branched; branches digitate, nodose, pollachotomous; structure subcavernous; colour dark house-mouse; spicule pin-like, with large *spherical* head. Size of specimen about $5\frac{1}{2} \times 3$ inches.

Suberites, ? sp. Undescribed. Liverpool Free Museum. Structure charged with grit, ? sea-bottom detritus; colour deep carmine. Australia.

Suberites, ? sp. Undescribed. Mauritius. *Character*. Massive, growing into short branches on the surface; colour ochre-yellow. In my cabinet.

Suberites, ? sp. Undescribed. *Character*. Massive, growing into short branches; colour ochre-yellow. Coast of Portugal. Kent collection, British Museum, no. 4. Size $3 \times 4 \times 1\frac{1}{2}$ inches.

Suberites massa, Sdt. *Character*. Massive, sub-branched; colour ochre-yellow. Adriatic. Type specimen in British Museum.

N.B. The last three species will probably be found to be the same.

Suberites, ? sp. *Character*. Massive, growing among and enclosing shell-detritus; colour ochre-yellow. Tucacas, in "small lagoon." Expedition of the 'Argo.'

Obs. The habit of enclosing fragments of hard calcareous objects, which finally disappear among the substance, is very common among the Suberites, giving them a gritty character; but whether this be for the organic or mineral matter, or both, that they contain, I am not able to say; it may be for the carbonic acid with the lime; but be this as it may, *Suberites domuncula* is often found under a shell-like form, having thus destroyed the shell itself on which it grew, while the destruction of shell-tissue by the burrowing (excavating) sponges is notorious.

With flesh-spicule.

Spirastrella cunctatrix, Sdt. 1, Algiers, "im frischen Zustande wahrscheinlich violet oder roth." 2, Mauritius, ? violet or purple washed out. Bowerbank collection, British Museum. 3, Australia; colour the same; specimen rounded by attrition; surface rough, tuberculate; size $6 \times 4 \times 2$ inches. Bowerbank collection, British Museum. Spinispirula very stout, the largest and most perfect about 10-6000ths inch long.

Spirastrella cunctatrix, variety. Mauritius. On a little crab's back about half an inch in horizontal diameter. Liverpool Free Museum. *Character*. Amorphous; colour white. Spinispirula very short and thick, composed of two bends 11 by 9-6000ths inch in its greatest dimensions (including the spines). This appears to be a *monstrous* "variety" on account of the number of grotesque forms assumed by the skeletal spicule in which the spinispirula appears to take part.

Suberites, ? sp. Undescribed. *Character*. A group of obconical tubes united at the base, presenting a warty or tuber-

cular surface outside; colour ochre-yellow. Size $6 \times 4 \times 2\frac{1}{2}$ inches. Australia. Bowerbank collection in British Museum. Spinispirula stoutish, consisting of four bends 10-6000ths inch long.

Suberites, ? sp. Undescribed. Mauritius. *Character.* Massive; colour ochre-yellow. A fragment in my cabinet. Spinispirula thin, small, consisting of three bends 5-6000ths inch long.

Suberites, ? sp. Undescribed. Belize. *Character.* Massive, lobate; verrucose on the surface; colour ochre-yellow. Liverpool Free Museum. Presented by Dr. Archer. Spinispirula thin, but very perfect, consisting of four bends 10-6000ths inch long.

Suberites coronarius, mihi. Undescribed. Honduras, Jamaica, Bahama Islands. *Character.* Massive, lobate, verrucose on the surface; colour ochre-yellow. Bowerbank collection, British Museum. Spinispirula consisting of one bend, semicircular, with the spines on the outside and over the ends only; spines capitate and in single file. Size about 4-6000ths inch long (Pl. XII. fig. 27, *b*, *c*).

Suberites, ? sp. Undescribed. Trincomalee. *Character.* Massive, sessile, growing up into conical lobes, more or less rugose at the base, warty; colour dark yellowish brown. Size $3 \times 2 \times 1\frac{1}{2}$ inches. Bowerbank collection, British Museum. Spinispirula variable in size; the largest consisting of four bends, 8-6000ths inch long.

Hymeniacidon angulata, Bk. (Proc. Zool. Soc. 1872, p. 632, pl. xlix.), Madeira. Sessile, coating; ochreous yellow. Size of largest piece $12 \times 7\frac{1}{2} \times 2$ inches. Spinispirula "minute," variable in form. No measurement given.

Alcyonium purpureum, Lam. Australia. Colour a beautiful carmine. Spinispirula, like all the rest, very variable in form and size, the largest and most perfect consisting of one and a half to two bends, 5-6000ths inch long (Pl. XII. fig. 28, *b*, *c*).

Of this sponge I have only seen a small slice, about 3 inches long and 1 inch square, evidently cut out from a much larger specimen, and bearing the condensed surface, with the subcavernous or subcompact structure internally, common to the group. (British Museum, "Lamarck collection," nos. 46 and 42 together.)

Compacta.

Without flesh-spicule.

Hymeniacidon carnosa, Bk. British Seas, = *Halichondria carnosa*, Johnst. Also from Vancouver's Island, between tide-marks. British Museum, no. 317, registered 68. 8. 17. 26, labelled "J. K. Lord, Esq."

Suberites montiniger, Cart. Barents Sea. Colour greyish black ('Annals,' 1880, vol. vi. p. 256).

With flesh-spicule.

Halichondria suberia, Johnst., = *Suberites domuncula*, Sdt. British and other seas. Flesh-spicule a short curved cylindrical acerate with obtuse ends, inflated in the centre, microspined and about 8-6000ths inch long. (Bowerbank, Mon. B. S. vol. i. pl. iv. fig. 95.)

Halichondria ficus, Johnst. British and other seas. Flesh-spicule the same.

Suberites montalbidus, Cart. Barents Sea. Colour greyish white. Flesh-spicule the same, but *pointed* at the ends ('Annals,' 1880, vol. vi. p. 256). ? Equal to *S. Lutkenii*, Sdt., Greenland (Spong. Atlant. Gebiet. S. 47).

Laxa.

Without flesh-spicule.

Cliona celata, Johnst. British and other seas. Burrowing in hard calcareous objects, especially oyster-shells, also in limestone rocks.

With flesh-spicule.

Cliona northumbrica, spinispirula 1-1800th, *C. vastifica*, s. 1-2100th, *C. corallinoides*, s. 1-2000th, *C. gracilis*, s. 1-1500th, *C. Howsei*, s. 1-600th, *C. mazatlanensis*, s. 1-1300th, *C. lobata*, s. 1-500th of an inch long. (Hancock, 'Annals,' 1867, vol. xix. p. 229, pls. vii. and viii.)

Cliona vermifera. *Smooth* spirula, five bends, "scarcely" 1-400th inch long. (Hancock, *ibid.*)

Cliona abyssorum. *Smooth* spirula, eight bends, 1-300th inch long. (Carter, *ibid.* 1874, vol. xv. p. 249, pl. xiv. fig. 33.)

Obs. It is easy to learn by the "smooth spirula" how the addition of spines forms the "spinispirula."

Cliona mucronata. Spinispirula 0·0006 inch long. *C. ensifera.* Spinispirula the same. *C. subulata.* Spinispirula thinner and longer, measurement not given. (Sollas, *ibid.* 1878, vol. i. p. 54, pls. i. and ii.)

Vioa Johnstonii, Sdt. (Spong. Atlant. Gebiet. S. 5, Taf. vi. f. 8). Colour carmine. Spinispirula four bends, 10 to 15-6000ths inch long. Type specimen in the British Museum.

Vioa Schmidtii, Carter, = *V. Johnstonii*, Sdt. (Spong. Adriat. Meeres, S. 78, Taf. vii. fig. 17). Skeleton-spicule acerate; flesh-spicule stelliform.

Rhaphidhistia spectabilis, Cart. Mauritius ('Annals,' 1879, vol. iii. p. 300, pl. xxviii. figs. 13 and 14). Skeleton-spicule acerate; flesh-spicule a spinispirula of nineteen bends, 1-300th inch long. The longest and most beautiful that I have seen.

Vioa Carteri, Ridley (Proc. Zool. Soc. 1881, p. 129, pl. xi. figs. 2 and 2 *b*). Colour carmine. Spinispirula ·0412 millim. long = 8-6000ths inch. "Victoria Bank," off S. Brazil.

It must not be thought that the foregoing list embraces the whole of the Suberites proper (that is, the sponges which belong to the four groups above mentioned), but rather only a few of them, to show that the pin-like skeletal spicule is often accompanied by a spinispirular or other flesh-spicule, as well as often without it. There are, of course, scores of instances in which neither might be the case, ex. gr. *Suberites fistulatus*, in which the skeleton-spicule is inflated at both ends and the flesh-spicule an equianchorate ('Annals,' 1880, vol. vi. pl. v. fig. 22). Or the skeleton may be acerate (pointed at both ends) and the flesh-spicule a stellate, as just noticed in *Vioa Schmidtii*, Carter. Then, in general form, the species may be furnished with long tubular appendages, as in *S. fistulatus* also; or the colour may be soot-black, as in *S. fuliginosus* ('Annals,' 1879, vol. iii. p. 347, pl. xxviii. fig. 9). In short, there are so many more sponges already described, and so many more likely to be discovered which might be relegated to one of the four groups mentioned, that, although in my "Notes" &c. I have proposed to give a third part, in which these and every other published species of sponges would be catalogued, I must, for want of time, leave this useful compilation to some one else, and content myself with the few suggestive remarks (notes) that I am now making.

There is also the genus "*Latrunculia*" of Bocage, in which an acuate or acerate skeleton-spicule, as the case may be, is,

in several species, combined with the flesh-spicule that I have termed "sceptrella" ('Annals,' 1879, vol. iii. p. 358, pl. xxix. figs. 13–21), which so often passes into the "spinispirula," that both forms may sometimes be found together in the same sponge, ex. gr. *Latrunculia corticata* ('Annals,' 1879, vol. iii. pl. xxvii. fig. 1, *a*, *b*, *c*).

Terpios fugax, de Fonbr. et Mich. (p. 102, pl. xxiv. fig. 6).

Laminiform, almost immeasurably thin, spreading over hard objects (*Porites*) in the manner of paint. Colour copper-green. Surface in form that of the object over which it may be growing. Consistence sarcodic (no fibre), charged with the spicule of the species, together with innumerable globular bodies (? cells), extremely minute and of a copper-green colour. Spicule of one kind only, viz. pin-like, smooth, very thin, slightly curved; head globular, acuminated terminally, followed by a thin shaft, which, after a short distance, gradually diminishes to a sharp point, about 70 by $\frac{1}{2}$-6000th inch in its greatest dimensions (Pl. XII. fig. 29), scattered plentifully and irregularly throughout the sarcodic film of which the sponge is composed. Size of the largest specimen about that of the branched one of *Porites furcatus* over which it has grown, about $3\frac{1}{2}$ inches in diameter.

Hab. Marine. Growing over hard objects.

Loc. Falmouth Harbour, Antigua.

Obs. This appears, from description and illustration, to be *Terpios fugax*, De F. et M.; but, from the form of the spicule not having been given, it is impossible to go beyond the description and representation for identification.

There is a species which grows on the rocks of this shore (Budleigh Salterton) in small patches, to which I have alluded in my paper on the "Parasites of the Spongida" ('Annals,' 1878, vol. ii. p. 164), chiefly to notice the presence of the parasitic oscillatorian (*Hypheothrix cœrulea*, Carter) to which it owes its beautiful colour; but as I have never published any description of the sponge itself, I will now do it under the name of

Terpios cœrulea.

Laminiform, almost immeasurably thin, spreading in little patches over the surface of the New Red Sandstone rocks here. Colour cobalt-blue when fresh, fading much on drying, but not disappearing altogether. Consistence sarcodic (no fibre), charged with the spicule of the species, and innumerable short parasitic oscillatorian filaments (*Hypheothrix*

cærulea, Carter), whose granules or cells bear the colouring-matter of the sponge (Pl. XII. fig. 30, *b*, *c*). Spicule of one kind only, viz. pin-like, smooth, slightly curved; head globular, acuminated terminally, followed by a narrow, annular inflation, and then a conical shaft, which, after a short distance, becomes diminished gradually to a sharp point; about 80 by 1-6000th inch in its greatest dimensions (fig. 30, *a*); scattered plentifully and irregularly throughout the sarcodic film of which the sponge is composed. Size of largest specimen seen about half an inch square.

Hab. Marine. Growing over hard objects.

Loc. Budleigh Salterton, S. Devon.

Obs. This appears to be an instance of what the Germans call "symbiosis." There is very little difference, except in colour, between it and the foregoing species, viz. *Terpios fugax*; hence I have adopted De Fonbressin and Michelotti's generic name for this kind of sponge. The form of the spicules appears to be the same, in so far as they are not fusiform, but diminish gradually from the head to the point, that of the British species being the largest. As regards the colouring material, this is situated in free granules (? cells) in *Terpios fugax*, which in *T. cærulea* are in short oscillatorian sheaths. Dr. de Fonbressin in his "Review" states that, as these sponges often penetrate into the cavities of marine objects (? *Vioa viridis*, Sdt.), the genus *Terpios* establishes "une véritable transition aux Eponges perforantes" (p. 49)—that is, the excavating Suberites in my group *Laxa*. Of the same character appear to be *Rhaphidhistia spectabilis* and *Hymerhaphia spiniglobata* (Annals, 1879, vol. iii. pp. 300 and 301, pl. xxvi. figs. 13 and 15, &c.).

DONATINA.

Turning our attention to the remaining group in the family Suberitida, viz. "*Donatina*," we find its subdivision already foreshadowed by the number of different sponges hastily, and therefore *provisionally*, inserted under this heading ("Notes," &c., p. 198).

Thus all the species from *Suberites appendiculatus* to *Trachya pernucleata*, with their like, might be included under a group named "Polymastina," as stated in the 'Annals' of 1876 (vol. xviii. p. 392), which group might be again subdivided into two sections, one of which presents a delicate structure and is well represented by the British species in Dr. Bowerbank's third volume, ex. gr. *Polymastia robusta* (Mon. B. S. vol. iii. pl. x. fig. 5, 1874), and the other just the opposite, viz. an *intensely compact* and hard structure,

well represented by the Cape species briefly described in the 'Annals' (*l. c.* p. 393), for which I would now propose the name of *Trachya durissima*, as the genus was characterized in 1870 ('Annals,' vol. vi. p. 178, pl. xiii. figs. 11–16). The spiculation in both sections is the same, viz. a stout skeletal spicule radiating from the centre, faced by a minute one which, inserted between the pointed ends of the former, gives a compactness to the surface; both spicules are for the most part acuate or pin-like, although the skeletal one in *Trachya pernucleata* (*op. et loc. cit.*) happens to be acerate; while the extreme compactness of the genus *Trachya* makes it resemble *Donatia lyncurium* so much that the Cape species of Polymastina (viz. *Trachya durissima*) might be easily mistaken for it at first sight. Keller's *Tuberella*, found in the Bay of Naples, appears to me to belong to this section (Archiv f. mikroskop. Anatomie, Bd. xviii. S. 276, Taf. xiv. 1880).

For *Axos Cliftoni* I have provisionally proposed a group under the name "Axona" ('Annals,' 1881, vol. vii. p. 381); but, as already stated, the examination of the species *Phorbas amaranthus*, de F. et M., from the West Indies, has thrown so much light on the Australian species *Axona anchorata* and *A. fibulata*, which were described from very "imperfect specimens" ('Annals,' *l. c.* pp. 382, 383), that I would now relegate them to the group Halichondrina under the generic name of "*Phorbas.*"

XENOSPONGIA.

For *Xenospongia patelliformis*, from Torres Straits, and *Halicnemia patera*, Bk., a British species, there might be a group named "Xenospongina," = Xenospongiadæ, Gray ("Arrangement of Sponges," Proc. Zool. Soc. 1867, p. 547). See spiculation (Pl. XII. fig. 32, *a–c*).

PLACOSPONGIA.

Again, for *Placospongia melobesioides*, from Borneo, Ceylon, and South America, there might be a group named "Placospongina," = Placospongiadæ, Gray (*op. et loc. cit.* p. 549), in which the skeleton-spicule is pin-like (Pl. XII. fig. 33, *a*, *b*), combined with a spinispirular flesh-spicule, like that of a Suberite (fig. 33, *e*, *f*, *i*), *faced* and *axiated* (for the sponge is branched) by a massive aggregation of elliptical siliceous balls like those of a *Geodia* (fig. 33, *c*, *g*), or mixed with a small spherical subspined one like that of *Chondrilla nucula* (fig. 33, *d*, *h*)—thus uniting in spiculation two groups, viz. the *Suberites*, as above divided, and *Geodina*, in which the spicular characters of the former preponderate.

Donatia.

Lastly, we come to the only remaining species in "Group 14," viz. *Donatia lyncurium* (after which it was named "Donatina"), which, being a corticate sponge with a peculiar structure and spiculation still allied to the family Suberitida, will be best left where it is.

Hence the emended classification would stand thus:—

Order VI. Holorhaphidota.

Family 2. **Suberitida.**

Group 1. Cavernosa.	Group 5. Polymastina.
2. Subcompacta.	6. Xenospongina.
3. Compacta.	7. Placospongina.
4. Laxa.	8. Donatina.

It must not be considered that these are all hasty speculations, which have only to be read and forgotten, but rather that they are attempts to reduce to useful classification a number of objects which, although a part of Nature's creation, have hitherto been almost contemptuously disregarded, not so much perhaps from their having passed unnoticed, as from the question whether they belong to the animal or vegetable kingdom having been undecided. But now that they have been admitted to belong to the former, the subject must be seriously grappled with by the comparative anatomist, and a classification developed for aiding the memory, which, as in other instances of the kind, can only be produced by time, thought, and experience extending over many generations, like that of botany.

Returning to a description of the sponges belonging to the Liverpool Free Museum, I have now to add that of a curious variety of *Donatia lyncurium* dredged by Capt. W. H. Cawne Warren in the harbour of Acapulco, after which a brief history of the species of *Donatia* will be given.

Donatia multifida, n. sp. (Pl. XII. fig. 22, *a–e*.)

Membraniform, lacinulate, expanded, flat or erect, fan- or vase-shaped, proliferous. Texture hard, tough. Colour now pinkish. Surface even, presenting white lines radiating from the excentric expansions to the circumference, which is fimbriated by irregular lacinulate processes of variable length, ending in thin expansions of attachment, by which they become adherent, like the tendrils of a scandent plant, to

the hard objects (empty shells, &c.) among which the sponge may be growing (Pl. XII. fig. 22); terminal expansions of the processes charged with the flesh-spicules of the species, into which the "white line" in the process, consisting of a bundle of skeletal spicules, is spread out. Spicules of four kinds, viz.:—1, skeletal, acuate, smooth, straight or very slightly curved, obtuse and almost imperceptibly inflated at the big end, then as slightly constricted and followed by a fusiform shaft, which terminates gradually in a round point in the largest and in a sharp one in the rest, about 138 by $2\frac{1}{2}$-1800ths inch in its greatest dimensions, but of all sizes under this measurement; 2, flesh-spicule, globostellate, 4-1800ths inch in diameter; 3, flesh-spicule, stelliform, 3–6-radiate, rays long, straight, or crooked, branched or spined irregularly, parting from each other directly (that is, without nucleus or body in the centre, thus opposed to the "globostellate" form), about 10-6000ths inch in diameter (Pl. XII. fig. 22, *d*); 4, flesh-spicule, minute, sexradiate, body globular, rays straight, ending respectively in globular inflations, which are microspined, about 3-6000ths inch in diameter (fig. 22, *e*). No. 1 is chiefly confined to the radiating bundles which form the skeleton; nos. 2 and 4, in great abundance, chiefly to the circumference, among which no. 3 is sparsely scattered. Size variable, according to extent of development; the largest specimen about an inch in diameter exclusive of the circumferential filaments.

Hab. Marine. Growing plentifully among the detritus of the sea-bottom in 4–9 fms.

Loc. Acapulco.

Obs. This sponge in structure, spiculation, and colour is precisely like *Donatia lyncurium*, but differs from it in its mode of growth, which looks like a globular form that had been shattered by some explosive force in the centre (Pl. XII. fig. 22, *a a*). Frequently it presents a floral or cup-like form, erect or inverted, with a naked central portion like a pistil in the centre (fig. 22, *f*). The filaments from the circumference seem to serve the purpose of propagation as well as attachment.

General Observations.

As *Donatia lyncurium* appears to be a world-wide species, for I have myself had specimens from Great Britain (this place), the West Indies ('Argo' expedition), the Cape, Mauritius, and South Australia, independently of the other places in which it has been found, whose differences in hardly any instance are sufficient to justify a multiplication of species, although they may

require a different nomenclature, I will here briefly state its history.

Dimly introduced among his "Alcyones" about 1725 by Marsigli, we are chiefly indebted to Donati for the first good description and figure of this sponge, in 1750, under the name of *Tethya sphærica* (Storia nat. marin. Adriatic. Venet. pp. 60–64. n. 1, 2, tab. x.). Lamarck called it *Tethya lyncurium* (An. s. Vertèbres, 1816, vol. ii. p. 386). Montagu, in 1818, was the first to call it *Spongia*, and place it among the species of British sponges then known (Wern. Mem. vol. ii. p. 117, pl. xiii. figs. 4 and 5). In 1833 Nardo gave it the name of *Donatia lyncurium* ('Isis,' p. 522, Spongiariorum Classificatio); and Johnston introduced it into his 'History of British Sponges,' &c., under Lamarck's name (p. 85 &c. pl. i. figs. 9 and 10). In 1862 Schmidt, thus following Johnston and Lieberkühn (Spong. Adriat. Meeres, S. 44), and Bowerbank in 1866 (Mon. B. S. vol. ii. p. 92), used the same appellation.

Now came the time for separating the "*Tethyæ*" of Lamarck; and thus we find the late Dr. J. E. Gray, in his "Notes on the Arrangement of Sponges" (Proc. Zool. Soc. 1867, p. 492), making *Tethya lyncurium* of Lamarck the type of the first division of his family Tethyadæ under Nardo's name "*Donatia*," and *Tethya cranium*, Lam., that of the ninth division under the name of *Tethya* (*op. et loc. cit.* pp. 541 and 543 respectively).

The necessity for this separation became much more evident to me when I described and illustrated side by side *Donatia lyncurium*, from this place, and *Tethya arabica*, which I found *in situ* growing on a rock on the south-east coast of Arabia ('Annals,' 1869, vol. iv. p. 1, pls. i. and ii.). So that in 1875, when my "Notes Introductory to the Study and Classification of the Spongida" were published, I found it advisable to place *Donatia lyncurium* in the second family of my Holorhaphidota under the name of "*Donatina*," and *Tethya cranium* in the third or following family in the "Pachytragida" under the heading of "*Tethyina*;" thus it is to be hoped these two incongruous species may never again be brought together.

In 1872 the late Dr. Bowerbank described and figured a *Donatia* from S.W. Australia, which he called *Tethea Ingalli* (Proc. Zool. Soc. p. 119, pl. v. figs. 11–17); and the following year two other specimens which came from the same locality were named respectively *Tethea robusta* and *T. Cliftoni* (*ib.* pp. 10 and 16, pls. ii. and iii.); while in 1879 Dr. Béla Dezsö, of Kolozsvar, aided by Prof. F. E. Schulze's prepara-

tions, published two memoirs entering far more satisfactorily than any one who had preceded him into the general description of the microscopic characters and reproduction of *Tethya* (*Donatia*) *lyncurium* (Archiv f. mikroskop. Anatomie, Bd. xvi. S. 626, Taf. xxx.–xxxiii., and Bd. xvii. S. 151, Taf. xii.).

But in no instance has that spiniferous character of the ray been particularly noticed which is represented in my figure from a specimen of the British species found at this place ('Annals,' 1869, *l. c.* p. 27, pl. ii. fig. 6, *b*), to which I would now call attention, because its pointed and spinous form if enlarged would be analogous to that of no. 3 in *Donatia multifida* (fig. 22, *d*), and to that which we shall see hereafter becomes a character in the Cape species or variety. Sometimes the spines in the British species cover the end of the ray in the small staple stellate to such an extent as to simulate the presence of a globular inflation, which is actually the case in the Adriatic form (Béla Dezsö, *op. cit.* Bd. xvi. fig. 4), also in the Australian ones, as I learn from Dr. Bowerbank's figures (*loc. cit.*) as well as my own slides, and, indeed, in *Donatia multifida* (Pl. XII. fig. 22, *e*). But it is in the Cape species, which is more robust than any of the rest in its adult state as well as in its spiculation, that the three forms of flesh-spicules mentioned in *Donatia multifida* become most distinct, where "no. 2" (referring to the numbers in the description of *D. multifida*), the largest, viz. the globostellate, measures 30-6000ths, "no. 3," the stelliform, with spiniferous rays, 12-6000ths (Pl. XII. fig. 23), and "no. 4," the minute sexradiate, 3-6000ths of an inch in diameter respectively. In the specimen from Mauritius "no. 3" is only 5-6000ths inch in diameter; so that after all the *differences* are only in degree, and those only sufficient to form a variety. Still, hitherto it does not appear to me that this third form of flesh-spicule, viz. no. 3, so characteristically developed in the Cape species (fig. 23), has been publicly noticed.

Respecting varieties in spiculation, however, it should always be remembered that our observations are necessarily very limited, on account of their having to be made on perhaps only one or two fragments of the entire specimen, and that specimen perhaps the only one that can be obtained from the locality; whereas, if our observations had been extended further, our statements might have had to be modified, and therefore should always so far be considered provisional. Perhaps, too, for the same reason, the fragments examined by two individuals respectively might not contain exactly the same form of spicules.

Here I would also notice that the "globostellate" ("Notes,"

p. 33, *l. c.*) which comes nearest in form to that of *Donatia*, where the body is large and the spines short, is that of *Chondrilla nucula*, while that of *C. sacciformis*, Carter, from Mauritius, in size and figure is almost identical with it. Moreover there is a great resemblance in structure and spiculation between *Donatia lyncurium* and *Axos Cliftoni*, wherein the small flesh-spicule, viz. "no. 4" in the former, is almost identical in form with a similar one in the latter; and the globostellate of *Donatia lyncurium* only a modification of the sexradiate cross-like one with multifidly-spined rays in *Axos Cliftoni*, as may be seen where the *central part* or body of the latter is much enlarged.

Family 3. Pachytragida.

Group GEODINA.

Geodia tumulosa, Bk., Proc. Zool. Soc. 1872, p. 628, pl. xlvii.

On an agglomeration of two large pebbles &c. a foot in diameter, bearing two specimens of *Polytherses*, *Cliona caribbæa* in *Porites*, and four species of sessile stony corals, all of considerable size, (the largest *Polytherses*, which is conical, being 5 inches high and the same in diameter at the base), together with a large piece of wood *artificially squared* and somewhat eaten by marine animals, but by no means in a state of decay, is a specimen of *Geodia tumulosa*, Bk., which has grown over nearly one third of the mass, which was found at Puerto Cabello, in the Caracas. The specimen of *Geodia* is well characterized in Dr. Bowerbank's representation of this species, the localities for which are stated to be "Honduras and Jamaica," and therefore requires no description of my own beyond the above, which is given in detail, to show by the present state of the *wood* in the conglomerate with what rapidity these marine animals grow and thus firmly cement together such large detritus.

There is another, small, thin specimen, about 2½ inches square, that had also grown between stones at the island of St. Vincent, and seems to be De F. et M.'s *Geodia caribbæa*, in which the surface-character is different from that of the foregoing specimen (apparently their *G. gibberosa*, Lam.), but which I shall presently endeavour to show is but a variation of *G. tumulosa*, Bk., and, finally, *G. gibberosa*, Lamarck.

The spiculation is the same in both the specimens from Puerto Cabello and St. Vincent: that is to say, the zone-spicule in each consists of a long shaft, terminated by three simple arms expanded laterally and a little advanced (Pl. XII.

fig. 31); the forks and anchors, being the (so to speak) "grappling"-spicules, are of course always concomitants, although not always seen; while the large acerate body-spicule and the flesh-spicules, viz. the siliceous balls accompanied by the minute stellates, are also the same. Such is also the spiculation in the six species from the West-Indian seas described and illustrated by Dr. Bowerbank (Proc. Zool. Soc. 1872, '73, and '74), while there is such a sameness in other respects, that if nothing but the form of the specimens is to determine the species, so little dependence is to be placed on this that they may all be set down as the same, subject to variation.

General Observations.

The Geodina, like the Esperina, have in most instances so little that is different in their respective spiculations, that by this alone it is impossible to distinguish them. Size goes for nothing, since a large specimen may have large spicules and a small specimen smaller ones, while in both the *forms* are the same. Again, if we search for specific differences in general development and surface-characters, the same species under certain circumstances may assume different forms; so that, in fact, we have nothing to do but to consider them all as belonging to one species, whatever names may be used for the varieties. Thus the two specimens just mentioned have the same kind of spiculation, although the external or surface-characters differ in the way to which I shall more particularly allude presently. As already stated, the six species from the West-Indian seas, described and figured by Dr. Bowerbank (*op. et loc. cit.*), have the same kind of spiculation among themselves, and the same as those from Puerto Cabello and St. Vincent respectively. But Dr. Bowerbank has stated that the porous areas in his *G. tuberculosa* "appear like a series of impressions made by the point of a pin," while each of the porous areas in *G. tumulosa* presents a plurality of pores (P. Z. S. 1872, pp. 627 and 629 respectively); hence, if we combine the pinhole pores of *G. tuberculosa* with the adult form given by Dr. Bowerbank of *G. tumulosa*, we shall have just what is to be found in our species from Puerto Cabello, while the plurality of pores in the areas of *G. tuberculosa* may find its analogy in the specimen from St. Vincent. These facts seem to be repeated in the West-Indian specimens described and illustrated by De F. et M., inasmuch as it is stated of *G. gibberosa*, Lam., that the pores are "punctiformes" (p. 105, pl. xxv. fig. 1*a*), and that in their *G. caribbæa* the porous area is "finement réticulée" (p. 106, pl. xxiv. fig. 8). With refer-

ence to the former of their specimens, therefore, I cannot help identifying it with our specimen from Puerto Cabello, and the latter with that from the island of St. Vincent; for *both kinds* of pores *exist* on the surface of the latter. Thus Dr. Bowerbank's *G. tuberculosa* and *G. tumulosa* appear to me to be the same as Lamarck's *G. gibberosa*, which also came from the West Indies.

Now I have just boiled out in nitric acid fragments of both our specimens, viz. that from Puerto Cabello and that from St. Vincent. But for the spiculation generally of the latter being a little smaller, the two are identical; and yet the surface of the former is covered with pin-holes regularly and quincuncially arranged in a thick crust of siliceous balls, &c., while the latter is for the most part covered by a dermal reticulation in which the interstices are cribbled with pore-holes in a thin one.

This discrepancy I will now endeavour to explain. It may be remembered, 1st, that in many sponges, especially among the Holorhaphidota (ex. gr. *Halichondria panicea*, Johnst., *Esperia*), the pores are situated in plurality in the delicate films of dermal sarcode which tympanize the interstices of the skeletal reticulation, thus rendered cribriform; 2ndly, that in the Psammonemata, where the dermal sarcode is thicker and the interstices (that is, the polygonal divisions on the surface) much larger, the tympanizing sarcode is again divided by a minute subreticulation of soft colourless fibre, which appears in relief on the surface of the polygonal divisions respectively, and presents one or more pores in each of its interstices; 3rdly, that in many *Hircinia* this reticulation becomes still more evident by the addition of minute microscopic objects (sand-grains, fragments of sponge-spicules, &c.), which give it a strikingly beautiful lace-like appearance, especially from its whiteness when dry; 4thly, that this addition of foreign objects often goes on to such an extent as to thicken the lines of the reticulation into a continuous incrustation, leaving only the openings of the pores.

Now we have only to apply this to *Geodia*, in which the siliceous balls and their accompanying minute stellates represent the " minute foreign objects," to understand how, in the specimen of *G. gibberosa* from the island of St. Vincent, we have a plurality of pores in the interstices, and in that from Puerto Cabello single ones, like pin-holes, in the thickened crust. Indeed, as before stated, the two conditions exist together in the specimen from St. Vincent, and therefore prove that these differences only depend on degree of development.

Thus we are led to the conclusion that in the selection of material from foreign sources by the *Hirciniæ*, and in the supplying of it from itself by the *Geodiæ*, the sponge evinces the power not only of selection, but of transporting from place to place with definite arrangement what it requires, together with the power of producing this material itself when it cannot obtain it from other sources.

ADDENDUM.

Insert immediately after "Family 2. **Cavochalinida**," p. 277, *anteà*, the following:—

Patuloscula procumbens, n. sp.

Cauliform, rhizomatous, procumbent, solid, throwing up thumb-like hollow processes, or simply branched, with large patulous vents; processes short, erect, annularly inflated, increasing in size upwards, and somewhat contracted at the orifice, which is large and circular. Texture resilient. Colour pale amber or deep dark amber, bordering on purple, which is probably the real colour when fresh. Surface smooth, even. Composition fibrous, resilient. Spicule of one form only, viz. acerate, smooth, curved, fusiform, sharp-pointed, 20 by $1\frac{1}{2}$-6000ths inch in its greatest dimensions, small, and scanty. Size of specimen $5\frac{1}{2}$ inches high by $1\frac{1}{2} \times 7$ inches square.

Hab. Marine.

Loc. West Indies, Grenada.

Obs. The light amber colour which gives this specimen such a beautiful appearance seems to have been produced by cleansing with acids, since some specimens of the same species in the British Museum still retain a trace of the "purple colour" common to this kind of *Chalinæ*. Besides a similar specimen to that in the Liverpool Free Museum, which was presented to the British Museum by Mr. T. H. Higgin, F.L.S. (reg. no. 77. 3. 9. 3) there are others in the latter, viz. no. 140, registered 45. 5. 12–20 and –21, and no. 264, registered 45. 5. 12–13, –15 and –16. It is some time since I gave the above name to this species, which will illustrate the group "Tubulodigitata" in my classification; and at the suggestion of Mr. T. H. Higgin, F.L.S., I now add the description.

To the above may also be added two very fine specimens of the same family from Grenada, and in the 'Argo' collection, viz. *Tuba plicifera*, de F. et M. p. 53, pl. x. fig. 2, and *Tuba* (*Callispongia*) *Eschrichtii*, de F. et M. p. 56, pl. xii. fig. 1. The former illustrates group 8, viz. "Ciliata," in my Classification; and as the latter (which is more or less covered

with the usual aculeations) belongs to the genus "*Tuba*" as much as the former, I have given this generic name to it, but would place *this* in the 6th group, viz. "Aculeata." The specimen of *T. plicifera* is composed of thick ridged fibre, with a circular fringed orifice, about 10 inches high by 5 inches in diameter; and that of *T. Eschrichtii*, which is long and trumpet-shaped, is more or less covered with a remarkably irregular form of the outgrowth mentioned, about 16½ inches high and 3½ inches in the longest diameter at its orifice, which is elliptical and *not* fringed. All three specimens have the same light fawn-colour, and all three the same kind of acerate spicule; that of *T. plicifera* is 18 by ⅔-6000ths inch, and that of *T. Eschrichtii* 18 by ½-6000ths inch, in their greatest dimensions respectively, so that it is finest in the thickest fibre, but very scanty in all three.

Each specimen presents a young one at its base, which is *blind* at the free end (that is, without orifice).

List of part of the Sponges from the West Indies in the Liverpool Free Museum collected by the Rev. H. H. Higgins, M.A., labelled "Argo Expedition, 1876," *submitted for examination in the month of November* 1881.

CARNOSA.

Chondrilla nucula, *Sdt.*, p. 268.

CERATINA.

Luffaria cauliformis, n. sp., p. 268.
—— ——, var. rufa seu fusca, n., p. 269.
—— ——, var. elongoreticulata, n., p. 269.
Aplysina aerophoba, *Nardo*, p. 270.
—— compressa, n. sp., p. 270.
—— cauliformis, n. sp., p. 270.
—— longissima, n. sp., p. 271.
—— fenestrata, *de F. et M.*, p. 272.

PSAMMONEMATA.

Spongia officinalis *auctt.*, p. 272.
Hircinia caracasensis, n. sp., p. 273.
Polytherses, *de F. et M.*, p. 274.
Dysidea tubulosa, n. sp., p. 275.

RHAPHIDONEMATA.

Chalina rubens, *Pallas*, p. 276.
Patuloscula procumbens, n. sp., p. 365.
Tuba lineata, var. flabelliformis, *de F. et M.*, p. 277.
Tuba digitalis, *de F. et M.*, p. 277.
—— armigera, *de F. et M.*, p. 278.
—— plicifera, *de F. et M.*, p. 365.
—— Eschrichtii, *de F. et M.*, p. 365.

ECHINONEMATA.

Ectyon sparsus, *Gray*, p. 281.

Holorhaphidota.

Halichondria panicea, *Johnst.*, p. 282.
Isodictya simulans, *Johnst.*, p. 282.
Thalysias repens, *de F. et M.*, p. 282.
—— carbonaria, *Lam.*, p. 282.
Fibularia massa, n. sp., p. 282.
—— ramosa, n. sp., p. 283.
—— anchorata, n. sp., p. 283.
Halichondria birotulata, *Higgin*, Ann. 1877, vol. xix. p. 296.
—— isodictyalis, n. sp., p. 285.
Reniera digitata, *Sdt.*, p. 287.
Phorbas amaranthus, p. 287.
Esperia lævis, n. sp., p. 291.
Suberites ? sp., agglomerated with shell-detritus, p. 350.
Cliona caribbæa, n. sp., p. 346.
Terpios fugax, *de F. et M.*, p. 355.
Donatia lyncurium, *Nardo*, p. 359.
Geodia gibberosa, *Lam.*, =G. tumulosa, *Bk.*, p. 362.

List of Sponges dredged by Capt. W. H. Cawne Warren in the Harbour of Acapulco &c. in 4–9 fathoms, July 1880, *submitted for examination at the same time.*

Tuba acapulcoensis, n. sp., p. 279.
Reniera fibulata, *Sdt.*, p. 284.
Halichondria isodictyalis, p. 285.
Halichondria pustulosa (South Atlantic Ocean), n. sp., p. 285.
Donatia multifida, n. sp., p. 358.

EXPLANATION OF THE PLATES.

Note.—All the spicules, with the exception of figs. 31 and 32, are drawn to a scale of 1-48th to 1-6000th of an inch, that their relative sizes may be seen; but figs. 31 and 32, being of a much larger size, are, for convenience, drawn to a scale of 1-48th to 1-1800th inch. The "more magnified" views of the smaller spicules are upon no scale at all, but intended to show in a larger form that which cannot be well shown in a smaller representation.

Plate XI.

Fig. 1. *Halichondria pustulosa*, n. sp. (nat. size). *a a*, pustuliform eminences; *b*, the same, more magnified; *c*, skeletal spicule, long; *d*, subskeletal spicule, smooth; *e*, subskeletal spicule, short, spined; *f*, anchorate, front and lateral views; *g*, bihamate.
Fig. 2. *Halichondria isodictyalis*, n. sp. *a*, skeletal spicule; *b*, tibiella; *c*, anchorate, front and lateral views; *d*, bihamate; *e*, anchorate, more magnified, front and lateral views.
Fig. 3. *Reniera digitata*, Sdt. *a*, skeletal spicule; *b*, tibiella; *c*, microspined acerate.
Fig. 4. *Tuba lineata*, spicule of.
Fig. 5. *Tuba digitalis*, spicule of.
Fig. 6. *Tuba armigera*, spicule of.
Fig. 7. *Chalina rubens*, spicule of. *a*, point, more magnified.
Fig. 8. *Halichondria panicea*, Johnst. (*Amorphina*, Sdt.), spicule of.
Fig. 9. *Isodictya simulans*, Bk. (*Halichondria*, Johnst.), spicule of. *a*, point, more magnified.
Fig. 10. *Thalysias repens*, var. nov., spicule of. *a*, point, more magnified.
Fig. 11. *Thalysias carbonaria*, Lam., spicule of. *a*, point, more magnified.
Fig. 12. *Fibularia ramosa*, n. sp. *a*, skeletal spicule; *b*, bihamates.
Fig. 13. *Fibularia massa*, n. sp. *a*, skeletal spicule; *b*, small acerate; *c*, bundle of trichites; *d*, bihamates.

Fig. 14. *Fibularia anchorata*, n. sp. *a*, skeletal spicule; *b*, bihamates; *c*, anchorate; *d*, the same, more magnified, lateral view; *e*, sand-grains.

Fig. 15. *Phorbas amaranthus*, spicule of.

Fig. 16. *Esperia lævis*, n. sp. *a*, skeletal spicule; *b*, inequianchorate, front and lateral views; *c*, bihamate; *d*, bundle of trichites; *e*, minute inequianchorate; *f*, the same, more magnified, to show the sharp process of the shaft extended downwards.

Fig. 17. *Esperia Cunninghami*, n. sp. *a*, skeletal spicule; *b*, variously formed head in the same; *c*, inequianchorate, front and lateral views; *d*, ? bihamate; *e*, tricurvate; *f*, bundle of trichites; *g*, more magnified view of lower end of inequianchorate, to show extension of petaloid arm upwards into a sharp process; *h*, more magnified view of ? bihamate, to show its shape.

Fig. 18. *Esperia obscura*, n. sp. *a*, inequianchorate; *b*, the same, more magnified, in different views, to show its enigmatical appearance.

Fig. 19. *Esperia*, minute *equi*anchorate in several species of, *a*; *b*, more magnified view, to show its shape.

Fig. 20. *Hymedesmia Johnsoni*, Bk. *a*, skeletal spicule; *b*, tricurvate; *c*, "trenchant" anchorate in natural position, lateral view; *d*, the same, diagrammatic, to show its shape; *e*, earliest visible form.

Fig. 21. *Hymedesmia Schmidtii*, Carter, n. sp. *a*, skeletal spicule; *b*, bihamate; *c*, *d*, *e*, the same as just mentioned, this form being common to both species.

PLATE XII.

Fig. 22. *Donatia multifida*, n. sp., natural size. *a a*, sponges; *b b b b*, tendrils of attachment; *c c*, bivalve shells, covered with a melobesian incrustration; *d*, spiniferous stellate; *e*, small sexradiate stellate; *f*, pistil-like process of the centre.

Fig. 23. *Donatia*, Cape species. Spiniferous stellate.

Fig. 24. *Desmacidon titubans*, Sdt. *a*, skeletal spicule; *b*, subskeletal spicule; *c*, bihamate; *d*, anchorate; *e*, *f*, *g*, different views of the anchorate, more magnified, to show its *equi*terminal shape, &c.; *h*, rosette form.

Fig. 25. *Spongia Dysoni*, Bk. *a*, skeletal spicule; *b*, spinispirula; *c*, the same, more magnified.

Fig. 26. *Cliona caribbæa*, n. sp. *a*, skeletal spicule; *b*, spinispirula; *c*, the same, more magnified.

Fig. 27. *Suberites coronarius*, n. sp. *a*, skeletal spicule; *b*, spinispirula; *c*, the same, more magnified.

Fig. 28. *Alcyonium purpureum*, Lam. *a*, skeletal spicule; *b*, spinispirula; *c*, the same, more magnified.

Fig. 29. *Terpios fugax*, spicule of.

Fig. 30. *Terpios cærulea*, n. sp. *a*, spicule of; *b*, Oscillatorian filament; *c*, the same, more magnified.

Fig. 31. *Geodia gibberosa*, Lam. Zone-spicule of.

Fig. 32. *Xenospongia patelliformis*. *a*, skeletal spicule; *b*, stelliform flesh-spicule, largest size; *c*, the smallest size seen.

Fig. 33. *Placospongia melobesioides*. *a*, skeletal spicule; *b*, head of same, of a different form; *c*, large siliceous ball, elliptical; *d*, small siliceous ball, spherical; *e*, *f*, spinispirulas; *g*, surface of large siliceous ball when fully developed, much magnified; *h*, spherical ball, more magnified; *i*, spinispirula, more magnified, to show its spines &c.

XXXVII.—*Is* Limulus *an Arachnid?* By A. S. Packard, Jun.*

In an article by Professor E. R. Lankester in the 'Quarterly Journal of Microscopical Science' for July and October 1881, entitled "*Limulus* an Arachnid," the author, distinguished for his histological and embryological papers especially relating to Mollusks and Cœlenterates, takes the ground that *Limulus*, or the horseshoe or king crab, "is best understood as an aquatic scorpion, and the scorpion and its allies as terrestrial modifications of the king crab;" and on p. 507 he makes the following startling announcement:—"That the king crab is as closely related to the scorpion as is the spider, has for years been an open secret which has escaped notice by something like fatality." While appreciating the thorough and critical nature of the learned author's work, especially observable in his excellent paper on the structure of *Apus*, we venture to assert that in regard to the systematic position of *Limulus* Professor Lankester has mistaken interesting analogies for affinities, and has on quite insufficient and at times wholly hypothetical grounds rashly overlooked the most solid facts and safe inductions from such facts, and arrived at very forced and, it seems to us, strange and quite untenable conclusions.

At the outset it will be remembered that *Limulus* differs from the Tracheates, including the Arachnids, in having no tracheæ, no spiracles, and no Malpighian tubes. It differs from Arachnids in these characters, also in having compound eyes, no functional mandibles or maxillæ, the legs not terminating, as is generally the case in Tracheates, in a pair of minute claws; while its brain does not, as in Arachnida, supply both eyes and first cephalic appendages. On the other hand, *Limulus* agrees with Crustacea in being aquatic and breathing by external gills attached to several pairs of biramous feet; in having a simple brain, which, as in some groups of typical Crustacea (Branchiopoda, &c.), does not supply any of the appendages, while the structure of the circulatory, digestive, and reproductive organs agrees with that of the Crustacea; and, as we have shown in our "Embryology of *Limulus*" ('American Naturalist' for 1870), the development of *Limulus* is like that of certain other Crustacea with a condensed metamorphosis, the possession of an amnion being paralleled by that of *Apus*. In all essential points *Limulus* is a Crustacean, with some fundamental fea-

* From the 'American Naturalist,' April 1882. Communicated by the Author.

tures in which it departs from the normal Crustacean type, and with some superficial characters in which it resembles the scorpion. The importance of these superficial characters Mr. Lankester exaggerates, and upon them with a number of supposititious, *à priori*, pseudo-facts he constructs, by a process quite the reverse of the inductive method, a new classification of the Arachnida.

We will now briefly criticise some points insisted on by Professor Lankester; and first, on p. 510, as regards the ensheathing of the nervous cord by an actual arterial vessel. This is to be met with in a less marked degree in the insects (Lepidoptera) as well as scorpions. As regards the comparison of the nervous system of *Limulus* with that of the scorpion, the comparison and statement made in our second memoir, which Lankester sets aside, was based on a month's careful study and description of the nervous system, particularly the brain of the scorpion, while our author draws his inspiration from Newport's account and figures. The differences between the brain and thoracic ganglionic mass of the scorpion and that of *Limulus* are not even correctly stated by our author. The brain of the adult scorpion, as we stated on p. 7 of our second memoir, sends off nerves to the simple eyes *and to the first pair of appendages*; in *Limulus* the brain supplies the eyes alone, the first pair of appendages being supplied from the commissures, as in all phyllopod Crustacea. Had Mr. Lankester examined for himself the brain of the scorpion, he would not have given the strangely incorrect account on p. 511. In the first place, the nerves to the first pair of appendages arise from the brain itself, as we have seen and as has been stated by other authors*, and not, as Lankester says, from the œsophageal collar. Moreover, as we stated, the brain is situated in the top of the head of the Arachnida, and not on the same plane as the œsophageal collar as in *Limulus*. In regard to the morphology (not the internal structure) of the brain, *Limulus* much more nearly approaches *Apus* and other Phyllopods than the scorpion and other Arachnida.

In discussing the external anatomy of *Limulus*, Mr. Lankester claims that between the sixth abdominal segment and

* Newport, whom our author quotes, expressly states that "immediately beneath the nerves to the eyes a large nervous trunk passes forwards from the front of the brain on each side to the small prehensile organs (*a*), which, in the scorpion, are modified antennæ." Balfour's embryological observations show that originally the brain of the spider is a double ganglion, the two forming the adult brain; our embryology of *Limulus* shows that the brain is from the beginning a single ganglion.

the spine there are six segments. We venture to suggest that four of these segments are purely imaginary. Embryology, as we have indicated in our figures, shows that there are but nine segments in the abdomen of *Limulus*, the spine forming the ninth. Our author speaks of the "postanal spine," when the anus is plainly situated in the base of the spine itself. It is a general law in the Arthropods that the anus opens in the terminal segment of the body. There are fifteen segments in the body of *Limulus*, as embryology abundantly shows. In order to compare the body of *Limulus* with its fifteen segments or arthromeres to that of the scorpion with nineteen, Mr. Lankester conjures up four additional segments, which are pure metaphysical inventions. The cephalothoracic plate or carapace is more than once styled a "sclerite." The author here (as usual) sets aside the embryological proof that the carapace is composed of the tergites of six segments, and allows, apparently as the result of his own independent observations (as if no one had previously *proved* it*), that the carapace may "be considered as representing six coalesced tergites." Partly on metaphysical grounds, and partly from the presence of movable spines on the sides, which, however, are situated on the anterior limb-bearing segments of the abdomen, as well as on the seventh and eighth limbless segments, our author is encouraged in the belief that these four hypothetical segments really exist. We prefer the plain teachings of observed facts, which are capable of demonstration and proof, and would ask for better evidence than this article affords of the existence of such segments. We would also continue to regard the anal spine as the telson. Lankester's "telson" is made up of the consolidated thirteenth and fourteenth segments of the body *plus* the anal spine or fifteenth (or ninth abdominal) segment.

Our author sets out with the foregone conclusion that he "must" find in the "abdominal carapace" of *Limulus* the representatives of the twelve abdominal segments of the scorpion, and so with a method of his own he creates them out of his inner consciousness.

* In a preliminary paper on the Embryology of *Limulus polyphemus* read before the Amer. Assoc. Adv. Science, August 1870, and printed in the 'American Naturalist' for October 1870, which our author has apparently not seen, the six segments of the embryo *Limulus* when in the trilobite stage are figured, and the number of thoracic segments is stated in the text. This paper is a summary of the memoir printed in the 'Memoirs of the Boston Society of Natural History,' and contains a general account of the embryology of *Limulus*, and appeared, with figures, over a year in advance of any other account of the embryology of *Limulus*.

In like manner he feels compelled to offer a new interpretation of the scattered, individual, simple eyes of the scorpion, and attempts to show that after all they are compound eyes, like those of *Limulus*, with the difference that in *Scorpio* they are "in a less compact form." Now the compound eye of *Limulus*, like that of the lobster or any other Crustacean or insect, possesses a common basally undivided retina, in *Limulus* a common undivided outer cornea, while the two simple eyes in *Limulus* have each a separate cornea, a separate retina, and each ocellus is supplied by a separate nerve arising independently from the brain.

In like manner our author labours to diminish the importance of the differences between the cephalothoracic appendages of the Arachnida and those of *Limulus*.

Professor Lankester then ventures, we think somewhat hastily, to homologize the first pair of abdominal appendages of *Limulus* with a little triangular median sternite in the scorpion. Then he fancifully homologizes the comb-like organs of the scorpion with the second pair of abdominal legs of *Limulus*, and also homologizes the respiratory lamellæ with the "lamelliform teeth of the scorpion's comb-like organs." The author further seriously attempts to homologize the four pairs of stigmata of the scorpion with the four last pairs of biramous respiratory feet of *Limulus*. On the same principle the stigmata of any insect are the homologues of its legs. What will Mr. Lankester do with the gill-plates of the Eurypterida, which are not arranged, according to Woodward, like those of *Limulus*, but are placed like the teeth of a rake?

Another surprise is added to the already long list by Mr. Lankester's discovery (of which he makes great account) of what he calls "parabranchial stigmata" in *Limulus*. He places them on the "sternal area of the segments;" but his statements on the succeeding page and his figures plainly show that these little muscular pits are situated at the base of the biramous abdominal legs. Is there an instance in nature of stigmata being borne on the legs? Is there the slightest possible reason for regarding these pits as stigmata? We are then treated to a long series of suppositions, accompanied by a series of elaborate hypothetical lithographic drawings, designed to "illustrate the hypothesis as to the derivation of the lamelliferous appendages of *Limulus* and *Scorpio* from a common ancestral form." The late appearance of the lamellæ on the feet of the embryo *Limulus* should teach any naturalist of sound judgment that they are most probably very special and late differentiations of the appendages. Besides this,

palæontology shows that in the Carboniferous period there were scorpions almost generically the same as the existing ones, and with them *Bellinurus*, closely resembling the Mesozoic and recent *Limuli*, which indicates that the latter type has always been a marine one, without any possible use for stigmata. Moreover the Eurypterine Merostomata with crustacean gills flourished as early as the Lower Silurian period.

Passing over, for want of space and time, the three or four pages of trivial criticisms of our own views by Professor Lankester, we are thus brought to the close of Mr. Lankester's article, and to his tabular view of his new classification of the Arachnida, one which is calculated at least to take away the breath of the ordinary systematist.

Any attempt at reasoning with our author, whose methods are so opposed to the inductive mode of scientific reasoning, and whose views are often founded on baseless hypotheses, would probably be fruitless. He is "surprised" that we should persist in believing that *Limulus* is a Crustacean.

We will in reply and to close this criticism simply quote some statements of the late Dr. von Willemoes-Suhm, whose important discoveries have been overlooked by all writers on *Limulus*. Our attention has been called to them through Mr. E. Burgess by Professor Walter Faxon, who has kindly sent us the subjoined extracts from von Willemoes-Suhm's letters.

The first reference by von Willemoes-Suhm was in the 'Zeitschrift für wissenschaftliche Zoologie,' xxix. 1877; writing from Yeddo under date of May 7, 1875, he says, "I have in the meantime discovered in the Philippines that the *Limulus* living there develops from a free-swimming larva, viz. a *Nauplius* stage, a fact of great significance to the whole doctrine of crustacean development. The preliminary notice concerning it, which I shall soon send to the Royal Society, will soon come to your notice. Packard and Dohrn have had to do with an animal which, like the crayfish, has a condensed development" (p. cxxxii).

A fuller statement is in a postscript to a letter written aboard the 'Challenger' to Professor Kupffer, dated "Zamboanga, Mindaua, 4 Februar, 1875," printed in 'Challenger-Briefe von Rudolf von Willemoes-Suhm, Dr. Phil., 1872–1875. Nach dem Tode des Verfasser herausgegeben von seiner Mutter,' Leipzig, 1877, pp. 157, 158. I am indebted to Professor Faxon for the extract, of which I give the following translation:—

"I send you this postscript in order to forward early in-

formation that it has befallen to me to find on the surface of the water here about five stages of development of *Limulus rotundicauda*, which does not, like the North-American species, according to Packard and Dohrn, directly develop, but passes through a *Nauplius* stage, with one, afterwards with three eyes, wholly like a Phyllopod. A tail-spine is present, but jointed above, and in this stage shows a parallel with *Eurypterus*. Packard's mode of development is a condensed one; and, as would appear, his, as well as Dohrn's and Van Beneden's, generalizations on the position of *Limulus* are throughout untenable, in so far as they remove this from the Phyllopods (*Apus* and *Branchipus*). They rather become closely allied through their common *Nauplius* with three pair of appendages; and a part of the 'Gigantostraken,' especially the Eurypteridæ, should be added to them.

"As soon as I reach Japan I hope to also examine the *Limulus* there. The larvæ here are unfortunately very rare and difficult to isolate; but I have good preparations of the most important stages. I hope to fall in with the northern species."

XXXVIII.—*Additions to the Australian Curculionidæ.*—Part IX. By Francis P. Pascoe, F.L.S. &c.

Eremninæ.

Pephricus rattulus.

Leptopinæ.

Lipothyrea, n. g.
—— chloris.
Leptops crassicornis.
—— furfuracea.
—— acutispinis.
—— glauca.
—— puellaris.

Amycterinæ.

Bubaris, n. g.
—— indemnis.
Amorphorhinus arcanus.

Gonipterinæ.

Oxyops niveosparsa.

Diabathrariinæ.

Atelicus abruptus.
—— crassipes.

Hylobiinæ.

Orthorhinus aspredo.
—— carbonarius.
—— lateralis.
—— posticus.

Erirhininæ.

Nemestra vibrata.
Aoplocnemis guttigera.
—— suturalis.

Pephricus rattulus.

P. obovatus, fuscus, squamulis griseis disjuncto tectus; antennis breviusculis; tibiis anticis intus obsolete serratis. Long. $2\frac{1}{2}$ lin.

Hab. Richmond River.

Obovate, brown, setulose, covered with approximate scales of a greyish hue, but only visible under a strong lens; rostrum and antennæ rather short; prothorax transverse, rounded; elytra shortly ovate, striate-punctate, interstices convex; anterior tibiæ obsoletely serrate internally.

This species is very like *P. echimys*, but differs in its shorter rostrum and antennæ; the joints of the funicle shortly cylindrical, not obconic, the second and third equal, not the second longest. The elytra also are decidedly shorter and more rounded at the shoulders. On the prothorax in both species there are little circles of scales radiating from a centre and placed sufficiently near to give it a reticulated appearance. One of my specimens has two fine white lines at the base of the elytra.

Lipothyrea.

Rostrum arcuatum, haud carinatum; *scrobes* submedianæ, postice latiores, ante aculos evanescentes. *Antennæ* tenues; *clava* distincta. *Oculi* infra acuminati. *Prothorax* breviusculus, basi truncatus, lobis ocularibus distinctis. *Scutellum* nullum. *Elytra* ovata, basi prothorace haud latiora. *Pedes* normales; *tibiæ* corbellis cavernosis. *Metasternum* breve. *Processus* intercoxalis latus, truncatus.

This genus may be placed near *Scotasmus*, Schönh., although it has cavernous corbels and no scutellum.

Lipothyrea chloris.

L. ovata; squamulis grisescentibus denso tecta, supra vittis duabus cæruleo-viridibus ornata; apicibus elytrorum acuminatis. Long. 3 lin.

Hab. Port Bowen.

Ovate, closely covered with brownish-grey scales, with two bluish-green stripes above not extending to the apex; the sides and body beneath also of the same colour; rostrum shorter than the prothorax; scape impinging on the eye; funicle with the two basal joints equal, very slightly elongate, the rest gradually shorter; club elliptic; prothorax transverse, base and apex truncate, sides rounded; elytra moderately convex, seriate-punctate, punctures numerous, distinct, slightly divergent at the apex, and apiculate; tibiæ and tarsi with paler and more scattered scales.

Leptops crassicornis.

L. ovata nigra, subnitida, parce silaceo-squamosa; antennis incras-

satis; rostro valido, in medio carinato; elytris tuberculis conicis instructis. Long. 7 lin.

Hab. Queensland (Mackenzie River).

Allied to *L. muricata*, but with stout antennæ and with fewer tubercles on the elytra; ovate, rather glossy black; head with a deep fovea between the eyes, below a narrow glossy carina with a deep groove on each side; funicle with all the joints except the first two transverse; basal joint of the club cylindrical; prothorax irregularly tuberculate, a rough excavation near the apex; scutellum small, indistinct; elytra with several small tubercles and larger conical ones intermixed, three of the latter on the inner and four on the outer side, the intervals filled with small reddish-yellow scales, and more so than on the prothorax; body beneath and legs with fine hair-like scales.

Leptops musimon, to which this species may be also compared, has, *inter alia*, a short stout rostrum, irregularly sculptured, and an elevated tubercle over each eye.

Leptops furfuracea.

L. oblongo-ovata, nigra, sat dense silaceo-squamosa; antennis attenuatis; rostro elongato, antice haud carinato; elytris postice tuberculatis, humeris acutis. Long. 6 lin.

Hab. New South Wales.

Oblong ovate, black, rather closely covered, especially on the elytra, with small reddish-yellow scales; antennæ very slender, second joint of the funicle longer than the first; rostrum as long as the prothorax, not carinated, the scrobe curving up towards the middle of the eye; prothorax slightly transverse, rugose, but scarcely tuberculate; scutellum rounded, prominent; elytra broader behind the middle, each with two lines of tubercles, those on the inner line gradually increasing in size, on the outer line less so, one terminating at the shoulder; legs rather slender.

The punctures on the elytra are somewhat foveiform and lined with scales, some of which, as on other parts, are mingled with larger ones. I do not know any near ally to this species: the sculpture of the elytra is similar to that of *L. quadridens*; but their form is different.

Leptops acutispinis.

L. ovata, nigra, squamulis albidis ubique dense tecta; elytris tricarinatis, humeris spina acuta armatis. Long. 7 lin.

Hab. Queensland.

Ovate, black, everywhere covered with whitish scales, those

along the suture tinged with yellow; rostrum robust, a slender somewhat abbreviated carina in front; antennæ slender, the first two joints of the funicle subequal, club blackish; prothorax transverse, with irregular punctiform impressions at the side, the middle with an oblong shallow depression not punctured; scutellum narrowly triangular; elytra rather broadly oval, seriate-punctate, punctures very distinct, the fourth series not extending to the base; on each elytron three well-marked carinæ, the inner terminating in a sharp spine; two smaller spines on the middle one posteriorly, and a slender acute spine at the shoulder at the commencement of the outer carina.

In my specimens the carinæ on the elytra are black, due, I think, to the scales being rubbed off. In colour this species resembles *L. cicatricosus*; otherwise it has no affinity with that or any other *Leptops* known to me.

Leptops glauca.

L. ovata, nigra, squamulis pallide glauco-viridescentibus sat dense tecta; prothorace oblongo; elytris carinatis. Long. 6 lin.

Hab. New South Wales (Bungendoře).

Ovate, black, rather closely covered with pale glaucous (inclining to greenish) scales; rostrum nearly as long as the prothorax, without a median carina, a short nearly obsolete groove on each side; antennæ slender, funicle with all the joints obconic, the first longest, second and third equal; prothorax about equal in length and breadth, slightly contracted at the base, a deep median line not extending to the apex; scutellum shortly ovate; elytra moderately convex, each with four carinæ covered with paler, or greyish-white, scales, the outer slightly callous at the shoulder; between the carinæ a double row of punctures nearly concealed by the scales; legs rather slender.

This species, on account of its simple carinæ and colour, may be placed near *L. hypocrita*, which has much broader elytra and a transverse prothorax.

Leptops puellaris.

L. oblonga, dense griseo-squamosa; prothorace elongato, basin versus gradatim attenuato; elytris valde convexis, breviter ovatis, interstitiis elevatis. Long. 3–3½ lin.

Hab. Queensland (Bathurst).

Oblong, densely covered with greyish scales; rostrum stout, subtricarinate in front; antennæ slender, second and seventh joints of the funicle equal, the first stouter and rather

longer than the second; prothorax longer than broad, rounded anteriorly, then gradually narrowing to the base, slightly tuberculate above; scutellum punctiform, indistinct; elytra not broader than the prothorax at the base, very convex, strongly rounded at the sides, striate-punctate, the punctures linear, interstices broadly elevated, the alternate ones larger and bearing a row of ligulate scales; legs densely scaled, with ligulate scales at intervals.

In this species the eyes are nearly round, and only very slightly, if at all, pointed beneath; it is one of those exceptions which may be found in almost every group. This species is remarkable for its narrow prothorax and very convex elytra, in the latter respect resembling *L. tetraphysodes*, but without its callosities. It is not unlike the species of White's New-Zealand genus *Brachyolus*, which I hardly know how to distinguish from *Leptops*.

Bubaris.

Caput antice convexum; *rostrum* basi angustius; *scrobes* arcuatæ; *antennæ* breves, funiculo incrassato. *Oculi* subtransversi. *Prothorax* apice haud productus, utrinque rotundatus, lobis ocularibus distinctis. *Elytra* postice latiora, humeris prominentibus. *Pedes* setigeri; *tibiæ* rectæ; *tarsi* breves, articulis tribus basalibus utrinque spina terminatis.

A genus with somewhat negative characters, differing from *Ædriodes* in its transverse eyes partially covered by the ocular lobes, and from *Mythites* in its narrow, but not filiform, tarsi. One of Lacordaire's characters for *Mythites*, the moniliform funicle, only applies to the type (*M. sulcicollis*). *M. pithecius* is congeneric with the species described below; it differs, *inter alia*, in having the prothorax prominent and rounded at the apex, not, however, produced so as to hide the head when viewed from above, as in *Dialeptopus*, *Amorphorhinus*, and others.

Bubaris indemnis.

B. ovatus, niger, prothorace apice truncato, granulis minusculis confertis munito, in medio leviter sulcato. Long. 4 lin.

Hab. Mackenzie River.

Ovate, black, head in front smooth; rostrum deeply sulcate; prothorax rounded at the sides, broad and truncate at the apex, above with closely-placed small granules; longitudinal median groove nearly obsolete, except anteriorly; elytra not broader than the prothorax at the base, much broader behind, irregularly granulate, granules small, approximate,

each tipped with a small seta, towards the apex rather abruptly declivous, the apex itself rounded (♂ only?); anterior tibiæ subbisinuate internally; second abdominal segment very little longer than the third.

Amorphorhinus arcanus.

A. obovatus, niger, squamositate silacea vestitus; prothorace granulato, in medio subsulcato; elytris rugosis, carinis granulatis duplici serie obsitis. Long. 4 lin.

Hab. Swan River.

This species resembles *A. australis*, Germ. (*Brachycerus*); but, *inter alia*, it has not the elevated ridge over the eye, but only a slight tubercle; the prothorax has several small granules, and in the middle a shallow linear longitudinal groove; and the elytra have two carinæ, just tipped with a line of small granules, not very marked on the inner carina; rostrum short and stout, with an oblong rhomboidal cavity in the excavation formed by the two ridges in front; antennæ ferruginous; prothorax with angular sides; elytra rugose, flattish between the two inner carinæ, with a row of oblique impressions next the suture; sterna and abdomen with small scattered punctures.

Oxyops niveosparsa.

O. ovata, nitide fusco-fulva, supra squamulis elongatis niveis condensatis maculatim ornata; rostro difformi. Long. 4 lin.

Hab. Queensland.

Ovate, glossy brownish fulvous, the elytra with conspicuous white spots composed of tufts of oblong scales; rostrum short, stout, abruptly gibbous in front, its junction with the head with a raised angular line; last three joints of the funicle transverse; prothorax closely granulate; scutellum narrow; elytra moderately convex, each slightly apiculate, roughly striate-punctate, punctures large, approximate, interstices granulate, especially at the base; body beneath and legs with scattered white scales.

The peculiar rostrum differentiates this species from all others known to me. It may be placed after *O. florea.*

Atelicus abruptus.

A. oblongus, ochraceo-squamosus; elytris, parte postica excepta, cinereis, basi haud tuberculatis, apice abrupte truncatis. Long. 3¾ lin.

Hab. Tasmania.

This species is allied to *A. inæqualis*, Waterh., but is somewhat differently coloured, the elytra not so parallel at the

sides, with narrower, more decidedly defined carinæ, the interstices broader, not tuberculate at the base, and the apex abruptly truncate, the two callosities on the truncated portion in *A. inæqualis* forming in this species an elevated transverse fold; antennæ shorter and stouter, the seventh joint of the funicle less closely joined to the club; on the prothorax a transverse slightly raised tubercular line curved forwards on each side, and of a lighter colour than the rest. The genus, which now contains seven species, is remarkable for the absence of the claw-joint.

Atelicus crassipes.

A. anguste cylindricus, ferrugineus, macula basali, prothoracis lateribus, humeris, et annulo in apice elytrorum fulvo-squamosis; pedibus crassiusculis. Long. 2 lin.

Hab. Western Australia.

Narrowly cylindrical, ferruginous; sides of the prothorax, spot at the base, scutellum, shoulders and ring on the apex of the elytra pale fulvous, caused by minute scales; head, rostrum, and disk of the prothorax apparently free from scales, the latter with scattered well-marked punctures; elytra scarcely broader than the prothorax at the base, seriate-punctate, the interstices set with very minute pearly scales, as on the prothorax; legs stout, femora and tibiæ closely covered with fulvous scales; tarsi less scaly.

Allied to *A. atrophus*, but more cylindrical, *i. e.* the sides of the elytra nearly parallel, the elytra not so long in proportion, and with fulvous scales on the shoulders, prothorax, &c.

Orthorhinus aspredo.

O. cylindricus, niger, tuberculatus, squamulis minutis albis adspersus; rostro elongato, recto; funiculo articulo primo elongato. Long. $6\frac{1}{2}$ lin.

Hab. Queensland.

Cylindrical, black, tuberculate, with minute white scales scattered between the tubercles; rostrum straight, half as long again as the prothorax, finely punctured, each puncture bearing a white scale; basal joint of the funicle as long as the four next together; prothorax constricted anteriorly, about as long as broad, a small tuft of ochraceous hairs on each side at the apex; scutellum nearly semicircular; elytra parallel at the sides, one or two rows of impressed punctures between irregular or unequal lines of tubercles, some of the tubercles tipped with a short spiniform process, base and middle of the elytra with a small tuft of ochraceous hairs, preapical callus also tufted;

beneath and legs with scattered white scales; anterior tibiæ not toothed internally.

A somewhat isolated species, except for the following; its most prominent character is the length of the basal joint of the funicle; the antennæ are inserted at about a third of the length of the rostrum from the apex.

Orthorhinus carbonarius.

O. subcylindricus, niger, tuberculatus, vix squamosus; rostro modice elongato; antennis apicem versus rostri insertis; prothorace apice haud fasciculato. Long. 7 lin.

Hab. New South Wales.

Stouter than the preceding, and less cylindrical, with scarcely any distinct scales; rostrum rather stout and not quite so long as the prothorax, reticulately punctured, each puncture bearing a small whitish scale; antennæ inserted near the tip of the rostrum, first joint of the funicle rather longer than the two next together; prothorax strongly constricted anteriorly, not fasciculate, and covered with approximate unequal tubercles; scutellum elevated, punctiform; elytra much broader than the prothorax at the base, with small punctures irregularly intermixed with unequal tubercles, the larger tubercles having an obvious linear arrangement, base and middle of the elytra slightly callous, preapical callus distinct; anterior tibiæ bisinuate internally.

The insertion of the antennæ is pretty close to the apex of the rostrum in this species, as in *O. arrogans* and some others.

Orthorhinus lateralis.

O. subcylindricus, piceus, tuberculatus, ochraceo-squamosus; elytris macula magna obliqua e squamulis condensatis notatis; prothorace apice bifasciculato; rostro tenuato, quam prothorax breviore. Long. 5 lin.

Hab. Lord-Howe Island.

Less cylindrical than *O. centurio*, Montr., with broader elytra and the oblique patch in the contrary direction, running from the base to the suture and meeting at about the middle; rostrum slender, shorter than the prothorax; insertion of antennæ remote from the apex; first joint of the funicle as long as the three next together; prothorax moderately constricted anteriorly, with small scattered glossy tubercles, the apex with two elevated tufts; scutellum transverse, densely squamose; elytra broader than the prothorax at the base, seriate-punctate, the interstices finely tuberculate, the alternate ones raised, preapical callus not prominent; legs rather stout; anterior tibiæ slightly bisinuate internally.

This species is rather closely covered with reddish-ochraceous scales, except where they form the fine white patch on the elytra.

Orthorhinus posticus.

O. oblongo-ovatus, piceus, squamulis albidis sparse irroratus, postice, scutello pedibusque ochraceo-squamosis; antennis ferrugineis, articulo primo funiculi elongato; rostro breviusculo. Long. $2\frac{1}{2}$–$3\frac{1}{2}$ lin.

Hab. Queensland (Wide Bay).

Oblong ovate, pitchy, speckled above with small whitish scales, the posterior third of the elytra closely covered with ochreous or buff-coloured scales; rostrum short; antennæ ferruginous, the first joint of the funicle as long as the three next together; prothorax transverse, finely granulate; scutellum scutiform, densely covered with ochreous scales; elytra not broader than the prothorax at the base, striate, the inner striæ with obsolete, the outer with foveiform approximate punctures, interstices with a raised line of small tubercles; body beneath and legs covered with ochreous scales.

Allied to *O. variegatus*, but differently coloured and with a shorter rostrum; one of my specimens has the prothorax bordered with ochreous scales.

Nemestra vibrata.

N. subelliptica, fusca, squamulis ochraceis albisque maculas formantibus vestita; funiculo elongato; elytris striatis, interstitiis leviter granulatis. Long. $3\frac{1}{2}$ lin.

Hab. Swan River.

Subelliptic, brown, with irregular patches of ochraceous and whitish or silvery scales, the latter more condensed, but varying with the individual; rostrum as long as the prothorax; antennæ ferruginous, funicle elongate, the first joint as long as the next two together, the remainder subequal; prothorax not longer than broad, slightly granulose, a white or silvery stripe in the middle; scutellum punctiform, covered with white scales; elytra elongate-cordate, the shoulders obliquely produced, striate, interstices with a line of distant almost obsolete granules; body beneath closely covered with silvery or opalescent scales; claw-joint ferruginous.

A stouter species than *N. incerta*, with a longer funicle, the upper parts less granulose, the elytra shorter comparatively and broader at the base. The genus may be distinguished by its quadrangular rostrum (*i. e.* in transverse section). It is allied to *Aoplocnemis*, Schönh.

Aoplocnemis guttigera.

A. anguste oblonga, rufo-picea, supra niveo-guttata, infra dense albo-squamosa; rostro elongato, striolato-punctato, apice latiore, punctato; elytris apice rotundatis. Long. $4\frac{1}{2}$ lin.

Hab. Victoria?

Narrowly oblong, reddish-pitchy, a spot at the base of the prothorax, and others (one a common central) on the elytra, and three or four on the side posteriorly, of snow-white scales; rostrum as long as the prothorax, striately punctured, the apex broader and simply punctured; funicle with the first two joints as long as the next four together; prothorax longer than broad, rugosely punctured; scutellum broader behind; elytra striate-punctate, interstices subtuberculate, apex rounded; body beneath covered with white scales; legs ferruginous, sparingly pubescent.

The coloration, with the two long basal joints of the funicle, are the principal differential characters of this species.

Aoplocnemis suturalis.

A anguste elliptica, fusco-picea, supra vittis tribus albis ornata; rostro punctato, quam prothorax longiore; elytris singulatim apiculatis. Long. 3 lin.

Hab. Melbourne.

This species is allied to *A. phalerata*, Er., but is narrower, more elliptic, and with comparatively longer legs; rostrum longer than the prothorax and simply punctured throughout, and scarcely broader at the apex; funicle with the first two joints as long as the next four together; prothorax with crowded punctures, the intervals irregularly raised; elytra substriate-punctate, the punctures large and squarish, the interstices, except near the suture, raised but not tuberculate, the apex slightly narrowed and rounded at the sides, but each elytron ending in an apiculus.

XXXIX.—*On some new Genera and Species of* Blattariæ *in the Collection of the British Museum.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

Two of the species described in the present paper have recently been obtained from the Rev. Deans Cowan, by whom they were collected in Madagascar; the others were added to the collection last year, and are from South India.

GROMPHADORHINA, Brunner v. Wattenwyl.

Of this extraordinary genus its author gives the following diagnosis in his analytical table of genera of Perisphæridæ, "*Mares alati* (?); feminæ apteræ;" but upon referring to his description of the same genus founded upon a male forwarded to him by M. Dohrn we find this diagnosis directly contradicted in the following words:—"Il a tous le(s) caractères du genre précédent (*Homalodemas*), à l'exception de l'absence totale des organes du vol et des tubercules du pronotum développés en forme de cornes." An examination of the figures of this singular species will convince any one that the latter is the correct description.

Fig. 1.

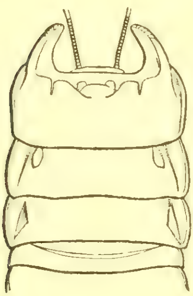


Fig. 2.

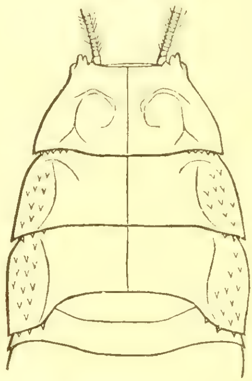


Fig. 1. *Dicellonotus lucanoides*, Butler.
Fig. 2. *Æluropoda insignis*, Butler.

1. *Gromphadorhina Brunneri*, sp. n.

♂. Pronotum black, shining, coarsely granulose, longer than broad, slightly contracted towards the front, which is regularly arched (not incised), and very strongly carinated along the anterior margin; the anterior two fifths slightly convex, much lower than the remainder of the surface, which is nevertheless deeply excavated in the middle in the form of a broad U, on each side of which are two obtuse cuneiform prominences (not cleft at their extremities as in *G. portentosa*); the lateral margins are slightly carinated: mesonotum bright castaneous, with blackish posterior border and a diamond-shaped central spot; very convex, oblong, a little wider at the sides than in the middle, but not produced backwards at the lateral angles, a fairly well-defined central longitudinal impressed line, and a number of scattered coarse shallow punctuations over the

whole surface: metanotum narrower than the mesonotum, distinctly produced at the lateral angles, and with slightly carinated lateral margins; castaneous, with a black posterior border formed of three confluent triangular patches; a fairly well-marked central impressed line, and a few fine punctures scattered over the surface. Abdominal segments black, the first four with castaneous anterior borders, the second segment concave in front and slightly sinuated behind near to the lateral angles, which are consequently prominent; remaining segments rectangular at the sides; all the segments finely and sparsely punctured, and with slightly carinated lateral margins; the second and third granulate at the sides behind, fourth segment with a series of small denticulate granules along the posterior margin; remaining segments covered with small granules; the supraanal plate is narrow and rounded at the sides; cerci broken in the type. Head longer than broad, blackish piceous, with the eyes, antennæ, and mouth castaneous; frons smooth, rather finely and sparsely punctured; a strongly embossed, transverse, slightly arched carina in the centre of the face, just in front of the antennæ. Femora above piceous, the tibiæ and tarsi black; femora below mahogany-red, flattened, finely and sparsely punctured; tibiæ blackish, coarsely spined at the sides and distal extremities; flat, and with a few fine punctures below; tarsi with soft pale stramineous pads; coxal plates mahogany-red internally, piceous with broad stramineous borders at the sides, from the keeled edge to the outer margin. First two ventral segments with deeply concave anterior margins; the first segment convex behind and subangulated at the lateral angles, remaining segments with concave posterior margins, and the lateral angles rounded off; the whole surface convex, smooth, but covered with fine punctures, the sides also with a few irregular impressed lines; the last ventral segment is deeply excavated behind in the form of an open Λ, but without the acute apex; the whole of the ventral segments are blackish, the last one with castaneous posterior margin; subanal plate almost square, but broader in front than behind, and with shelving rugose sides, black with the lateral borders ochreous. Length of body 42 millim., of pronotum 12 millim.; width of pronotum at the back 15 millim., of mesonotum 18 millim., of metanotum 19 millim.

Ankafana, Betsileo, Madagascar.

ÆLUROPODA, n. gen. (*αἴλουρος, πούς*).

Allied to the preceding genus, but differing totally in the form of the thorax, the pronotum of the male being transversely trapezoidal, with the anterior margin deeply excavated

and obtusely dentated at the sides, strongly keeled; the back of the pronotum also forms a nearly flat oblong transverse plane, a little higher than the anterior surface, and terminating on each side before reaching the margin of the pronotum in an obtuse angle; the meso- and metanotum are also deeply excised behind, the metanotum forming in consequence broad lateral pterygoid expansions; the antennæ extend nearly to the extremity of the abdomen and are coarsely setose in the male; the tarsi are provided below with large soft pads, as in *Gromphadorhina*; the cerci are short, not extending beyond the supraanal plate.

2. *Æluropoda gigantea*, sp. n.

♂. Black, with broad, deep-red lateral borders, but those of the pronotum variable in extent, sometimes reduced to a small spot on each side; the meso- and metanotum with large patches of the same colour in front, and the first three ventral segments with their anterior margins similarly coloured; the clypeus testaceous in front; anterior margin of the pronotum and antennæ clothed with ferruginous setæ; tarsal pads pale dull stramineous; the pronotum in adult examples is coarsely rugose and sparsely granulated at the sides; the meso- and metanotum are smooth in the centre, covered with fine reticulations, and finely and sparsely punctured, divided down the centre by a tolerably deeply impressed longitudinal line, marked on each side near the front by a small shallow impression, and close to the posterior margin by a large and irregular impression; the sides are obliquely depressed and somewhat concave, rugose and granulated; the abdominal segments are in structure similar to those of the preceding species, excepting that their lateral angles terminate in small spine-like denticles. On the under surface the structure is nearly the same as in *Gromphadorhina*; but the last ventral segment has its hind margin excised in a regular arch. Length of adult example 69–73 millim., of pronotum 12–14 millim.; width behind 26–33 millim., width of mesonotum at posterior angles 31–34 millim., of metanotum 30–32 millim.

Young examples are similar in structure, but less rugose than the adult ones; but very young larval forms have the pronotal excrescences and the excavation of the anterior margin considerably less pronounced, and therefore much more like the female, in which the anterior margin is scarcely more than a straight transverse line, even in adult examples.

The following sizes are before me, in addition to the adult males already noted:—♂ ♀, length 51–52 millim.; ♀, 47 millim.; ♂ ♀, 42–43 millim.; ♂ ♀, 35–38 millim.

Ankafana, Betsileo, Madagascar.

A female form also occurs, which I suppose to be merely a colour variety, in which nearly the whole of the abdomen is bright castaneous.

The following genus seems to me to be nearly allied to the *Panesthia forceps* of Saussure; but it is totally destitute of tegmina, which, according to M. Saussure (and as figured by him), are rudimentary, but nevertheless present in the female.

DICELLONOTUS, gen. nov. (*δίκελλα, νῶτος*).

Pronotum smooth, transverse, with the anterior margin excavated in front and more or less produced into projecting horns; head concealed by the pronotum; antennæ moniliform, rather short, not extending quite to the middle of the body; entire body above with a distinct marginal carina; supraanal plate very wide, transverse, with well-defined lateral posterior angles, its posterior margin scarcely perceptibly undulated in the middle; cerci extremely short and corneous.

3. *Dicellonotus lucanoides*, sp. n.

♀. Above deep mahogany-red, clouded and bordered with black, the posterior abdominal segments wholly black; below black, the femora reddish, the ventral segments with deep reddish posterior borders. Pronotum tumid, depressed in front, with the back of the depression plicated, and its surface bearing on each side a distinct embossed pustule; the anterior margin slightly convex in the centre, but deeply excised in its relation to the humeral angles, which are produced forwards into two long, robust, incurved, obtuse horns, keeled along their upper edge, which is a little tuberculated at its extremity, and with their inner surface transversely indented with irregular striæ; lateral margins strongly carinated and slightly rugose; posterior margin nearly straight, slightly convex; meso- and metanotum transverse oblong, of nearly equal width throughout, smooth, with rounded carinated lateral margins, near to which there is a longitudinal elongate triangular shallow depression. Abdominal segments with carinated lateral margins; coarsely rugoso-punctate at the sides, the first to sixth segments in the dorsal region and a patch near the front of the seventh segment almost smooth; the first and second segments with convex posterior margin; the anterior border of the segments is represented by a ribbon-like continuation of the lateral carina, which, on the seventh segment, is longitudinally finely striated at the sides. Head almost cordiform, irregularly striolate. Legs extremely power-

ful, shining, with a few scattered coarse shallow punctures; the tibiæ very coarsely spinose, anterior femora with two acute needle-like spines at about the middle of the inferior margin; anterior tibiæ very short, pyramidal in shape, the spines radiating; tarsi of all the legs rather short, smooth, without pads; ventral segments finely and irregularly striated in a transverse direction. Length (exclusive of humeral horns) 48 millim., with horns 54; of pronotum, including horns, 17 millim.; width 23 millim., of mesonotum 24 millim., of metanotum 26 millim.

South India.

4. *Dicellonotus morsus*, sp. n.

♀. Allied to the preceding species, from which it may be at once distinguished by the following structural characters:— Pronotum considerably narrower, slightly reflexed in front, and with a rather deep almost semicircular excision of the anterior margin, giving the impression of two flattened short protuberances, but quite unlike the humeral horns of the preceding species; the remainder of the pronotum very similar, though decidedly narrower, longer, and more convex; the abdominal segments are coarsely and regularly punctured almost all over, though more finely towards the dorsal region, the sides, however, are not rugose; the anterior femora have three needle-like spines, instead of two, on the inferior margin; and the head is decidedly longer and less cordiform. Length, including anterior processes, 47 millim.; pronotum between the processes 12 millim., including them 14 millim.; width 20 millim., mesonotum 23 millim., metanotum 25 millim.

South India.

XL.—*Descriptions of two new Species of the Homopterous Genus* Platypleura *from Madagascar*. By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

THE first species to which I have to call attention was obtained in 1879, from a collection made by Mr. Kingdon in Antananarivo. It has hitherto stood in the collection with *P. madagascariensis* of Distant, but is more nearly allied to *P. gigas*. It differs from both species in its inferior size, narrower head and notum, the almost rectangular anterior angles of the pronotum; and (being a female) it naturally differs in its small rounded lateral drum-flaps.

From *P. gigas* it also differs in the decidedly less prominent membrana costæ of the tegmina, and from *P. madagascariensis* in its longer and less hairy face.

I conclude that this cannot be the ordinary female of *P. gigas*, since it differs markedly from that species in size, pattern, and coloration, in addition to the structural distinctions above indicated. Should it prove to be so, the species would stand alone and distinct, even from its nearest allies, in having a female unlike itself; there is, in fact, extremely little variation either in form, pattern, or size, in individuals of the same species of *Platypleura*, at any rate, so far as my experience goes. I therefore regard the female before me as a distinct species, more nearly allied in structure to *P. Cameroni* than any other form yet described.

Platypleura angusta, sp. n.

Rufo-testacea, capite et pronoto irregulariter nigro signatis, meso- et metanoto lateraliter fusco striatis, maculisque rotundatis dorsalibus nigris; abdomine nigro, nitente: subtus capite pedibusque castaneis testaceisque; tympanorum laminis testaceis. Tegmina macula parva basali, alteraque apud basin, multo majore, oblonga, nigris, costalibus; area tota media maculis pyriformibus ovalibusque nigro marginatis variegata; plagis tribus fundo pallidioribus, prima fere media, secunda subcostali bifida, tertia ad angulum inferiorem sita; maculis submarginalibus sagittatis aliisque marginalibus nigris; venis fuscis. Alæ paululum pallidiores; area lata apicali et margine externo nigris. Corp. long. 31 millim., pronoti lat. 14, tegm. exp. 96.

♀. Antananarivo (*Kingdon*). Type, B.M.

Platypleura evanescens, sp. n.

Pallide viridis, tegminibus canescentibus, fusco maculatis, venis partim fuscis, alis paululum brunneo-nebulosis, lacinia abdominali præsertim fuscescente; maculis submarginalibus fuscis; capite notoque nigro maculatis; mesonoto antrorsum fusco-albido plagiato; abdomine castaneo, lateraliter nigro; corpore toto hic illic argenteo squamoso: tegminibus subtus multo distinctius fusco maculatis; corpore fusco-albido, albo squamoso; pedibus testaceis, castaneo variis. Corp. long. 34 millim., pronoti lat. 16, tegm. exp. 105.

2 ♂. Antananarivo (*Wills*). Type, B.M.

This species has the general coloration of *P. semiclara* of South Africa; the tegmina are formed as in *P. gigas*, with similarly expanded membrana costæ; the pattern of the markings on the tegmina is also as nearly as possible identical; the wings, however, are smaller, the face is shorter, the anterior angles of the pronotum more oblique, and the entire body narrower; the drum-flaps are shorter, formed as in *P. madagascariensis*; the preanal ventral plate is decidedly narrower and longer; the rostrum (as in *P. gigas*) extends to a point between the femoral articulation of the last pair of legs.

XLI.—*Form and Nature of the Cirrous Appendages on the Statoblast* of Carterella latitenta, *Potts*, *&c.*, *originally designated* "Spongiophaga Pottsi." By H. J. Carter, F.R.S. &c.

[Plate XIV.]

Up to the time of my publishing all that I could learn from Mr. Potts's "slides" respecting the cirrous appendages of the statoblast in that species of *Spongilla* which, in kind compliment to myself, he had named "*Carterella tenosperma*" (for which appendages I proposed the name "*Spongiophaga Pottsi*," to commemorate his interesting discovery), I could come to no other conclusion than that they were so closely allied to those filaments in some of the marine sponges for which I had proposed the name "*Spongiophaga communis*," that they might justly claim the same generic appellation ('Annals,' 1881, vol. viii. p. 354, pl. xvii.). But natural history is progressive (that is, evolutionary), like every other kind of human knowledge, which, on the other hand, is so entirely based on assumption, that one feels ashamed of the least precipitancy, and never safe except under the most modest utterance. Yet there are perplexing questions in which we are apt to forget this, and so rush at the merest shadow of assistance to help us out of our difficulties. From such arose my proposing the generic name "*Spongiophaga*" for the cirrous appendages on the statoblast of *Carterella tenosperma*—since, although the former is as abundant, common, and evident to our senses, in the Hircineæ, as the grass of the field, no one yet has been able to find out (with all our knowledge of creation) what it is or where it came from; but Mr. Potts's discovery of the cirrous appendages among the Spongillina, where they had never been known or even suspected to exist before, and their great resemblance to the filaments of *Spongiophaga communis*, led me to hope that a step towards the solution of this question had at last been attained; and thus originated the name "*Spongiophaga Pottsi*." Desirable, however, as it may be to find out any thing that will throw some light on the nature of *Spongiophaga communis*, it now appears to me that we cannot hope for much in this respect from the cirrous appendages of the statoblast; for in a specimen of *Carterella latitenta* lately received from Mr. Potts their form is so different and so much more indicative of their real nature that, whatever their office may be, their presence

in some species of *Spongilla* and not in others must be accepted as analogous to the presence of the cirri on the statoblast of *Pectinatella magnifica*, and their absence on that of *Plumatella*, or, to adduce a more homely example, the presence of horns in most cattle and their absence in the "Galloway breed."

Thus the "tubular prolongation of, and *not addition* to, the chitinous coat of the statoblast in *Carterella latitenta*, as I must now view it, is so much longer than that of *C. tenosperma*, that it bears the proportion of 5 to 1, or 1-90th inch in the former to 1-450th inch long in the latter (compare fig. 2, *f*, in Pl. XIV., with fig. 1, *f*, in pl. xvii. 'Annals,' *l. c.*); while in other respects it is much the same, being in direct continuation with the chitinous coat and open or closed at the free end, as the case may be. On the other hand, the "cirrous appendage" may be single or double (Pl. XIV. figs. 2, *g*, and 3, *g g*), and commencing in a broad ribbon-like form about 1-180th inch wide, which embraces the tubular prolongation after the manner of a flange, about 1-360th inch from its free end (fig. 2, *g m*), goes on diminishing in width for a certain distance, when the ribbon-like portion (fig. 2, *m m m*) may cease, and the cirrus may end in a single or double, *round* or cord-like filament, afterwards continuing a whip-like diminution to its termination, also like that of *Carterella tenosperma* (fig. 2, *i l*, and fig. 2, pl. xvii. 'Annals,' *l. c.*), altogether about one third of an inch long, or twelve times the diameter of the statoblast; but this, of course, is subject to much variety, as no two statoblasts are exactly alike in their measurements. The commencement of the cirrous appendage in *C. latitenta*, which, although broad, is very thin and transparent, may, if carefully examined under a microscope, be found to have a thickened, round, cord-like margin on one or both sides (fig. 2, *k k*), which, when traced to the termination of the ribbon-like portion, leave it *separatedly* in the round shape mentioned; generally one side is thicker than the other, while the latter often becomes so diminished as to disappear altogether, and thus leave the intervening membranous expansion in the form of a simple alar appendage. This, which renders the cirrus so much like a ribbon in *C. latitenta*, is not altogether absent in *C. tenosperma*, where it may frequently be seen to unite the filaments into a disk-like form around the tubular prolongation, especially in *C. tubisperma* (figs. 7, 8, and 9), when, as before stated, it recalls to mind the webbed arrangement of the tentacles round the mouth or beak of a Cephalopod. Thus, although differently formed in different species, the plan of development in the cirrus is the same; and thus the greater

length of the tubular prolongation in *C. latitenta*, together with the consequently greater interval between the union of the cirrous appendage and the chitinous coat of the statoblast, enables one to examine these parts under the microscope much more satisfactorily than in *C. tenosperma*, where their comparative shortness brings them close together, and thus renders their points of union more or less indistinct ('Annals,' *l. c.* pl. xvii. fig. 1).

Identical, however, as the cirrous appendages in the species of *Spongilla* are, I have not been able to trace any connexion between them and the interior of the tubular prolongation in *C. latitenta*, although in the rounded or cord-like portions an axial line may occasionally be discerned as in the filament of *C. tenosperma*.

Nor have I shown any union of this kind in my diagram of these parts in *C. tenosperma* ('Annals,' *l. c.* pl. xvii. fig. 2), although in the description it is assumed, from the axial line at the end of the cirrus widening, and its granular contents coming so near the like material in the tubular prolongation of the chitinous coat; for in the diagram, which is meant for a vertical section, the line "*d*" is made to circumscribe the tubular prolongation, which would not have been the case had my inference, as it now appears, been as truthful as the representation.

But the question here is not so much whether the axial cavity of the filament has a direct communication with that of the tubular prolongation, as whether the "glairy, fatty-looking globules" in the former are derived from the "germinal contents of the statoblast," all of which seems to be satisfactorily negatived by the form and disposition of the cirrous appendages in *C. latitenta*. Hence my premises in *C. tenosperma* (*op. et l. c.*) are worthless, and the argument based on them becomes an unfounded assumption.

I have alluded to the statoblasts of Prof. Leidy's *Pectinatella magnifica*, some of which Mr. Potts kindly sent me for germination; and I can see distinctly under the microscope an axial line of particles in the terminal branches of their cirri similar to that in the cirrus of *C. tenosperma* (fig. 6, *d*); so that the identity in structure and composition between the statoblast of *Spongilla* and that of the so-called "winter-egg" of the Bryozoa, which I endeavoured to show twenty-two years ago ('Annals,' 1859, vol. iii. p. 331, pl. viii.), is now, as Mr. Potts has stated (Proc. Acad. Nat. Sci. Philadelphia, Dec. 6, 1881, p. 460; and 'Annals,' April 1882), thus "rendered more complete"—a fact which may tend to make the

position of *Spongilla* in the animal series more clear than it is at present*.

But, in alluding to specific differences in the species which do bear the cirrous appendages and those which do not, I can only say that the spiculation of the statoblasts of *Heteromeyenia repens* (about which Mr. Potts himself seemed to have some doubt, as the label on his slide also bears "? *Meyenia Baileyi*") and those of *Carterella tubisperma* appears to me to present hardly more than "varieties" of *Spongilla Baileyi*, Bk. (Proc. Zool. Soc. 1863, p. 13, pl. xxxviii. fig. 6), of which unfortunately neither Mr. Potts nor myself possess a type specimen, so that we have nothing to fall back upon in this respect but Dr. Bowerbank's description and illustration, wherein at page 13 he observes that the birotulate spicule is "four or five times as long" as that of *Spongilla fluviatilis*, which corresponds with the representations (*op. et l. c.* figs. 1, *b* and 6, *b*), both of which are drawn to the same scale, viz. "× 660." But, to be sure of the actual measurements of the birotulates in *Spongilla Baileyi*, Bk., I applied for this to Mr. Stuart O. Ridley, F.L.S., who has charge of Dr. Bowerbank's *type specimens* now in the British Museum; and, in reply, he states that the birotulate spicules on the slide range from "93-25000ths to 147-25000ths inch" in total length, thus evidencing a heterogeneous mixture of long and short spicules, in this respect similar to what is characteristic of *Heteromeyenia repens*, but in the matter of length more nearly allied to the birotulates in *Heteromeyenia argyrosperma*, which, according to Mr. Potts's mounted specimen, range from 1-333rd to 1-146th inch, where the maximum is still greater than that of *S. Baileyi*. This heterogeneous mixture in length of the birotulates around the statoblast I observe to be the case in all three species of *Carterella*, but more so in *C. tubisperma* and *C. latitenta* than in *C. tenosperma*, where they are not only much shorter and much more equal in length, but so different in shape as to justify specific distinction.

Returning to the cirrous appendages, the tubular prolongation in the species which comes from Buffalo, viz. *Carterella tubi-*

* The little mass of statoblasts of *Pectinatella magnifica* from the Schuylkill river, Pennsylvania, which reached me in an equally small test-tube with water on the 9th November, 1881, began to germinate towards the end of February 1882, in well-water, occasionally changed during the interval. It was then transferred to a small freshwater aquarium (glass bowl) with *Anacharis alsinastrum*, where it continued to germinate freely up to the 8th April, when it gradually disappeared (? died out). Many of the statoblasts were entirely without cirri, although each opened like the rest, in the line of suture (after the manner of an oyster), and gave issue to a finely developed *Pectinatella*.

sperma (fig. 7, *f*), is still longer than that in *C. latitenta*, which, on the other hand, comes from the State of Pennsylvania; but the cirri themselves, although more numerous, are so reduced in size as to appear to be aborted when compared with those of the other species (figs. 7, *g*, and 8, *b*).

I have noticed, on this occasion, that the mamilliform process opening into the tubular prolongation of the chitinous coat is not given off from the latter, as represented in *C. tenosperma* ('Annals,' *l. c.* figs. 1, *e*, and 2, *e*, &c.), but appears to belong to the extremely thin membranous envelope of the germinal contents (Pl. XIV. fig. 2, *e*, &c.). The circular rugæ which are on the cirrus of *C. tenosperma* ('Annals,' *l. c.* fig. 2, *g*) I have not seen.

Of course, there is much variety in the growth of the cirrous appendages in *Spongilla*, since they could hardly belong to a *sponge* if this were otherwise: thus they may be very long, round, and whip-like, as in *C. tenosperma* ('Annals,' *l. c.* fig. 1, *g g g*), or ribbon-like, as in *C. latitenta* (Pl. XIV. fig. 2, *g g g*), or very small and in greater or less plurality, as in *C. tubisperma* (figs. 7 and 8); or there may be supernumerary ones in the form of buds, as in *C. latitenta* (fig. 4, *e e*), or branched and anastomosing reticulately towards the free termination in the same species (fig. 5); or there may be a double set of cirri on the tubular prolongation, one below the other, as in *C. tubisperma* (fig. 9); or in the same species the tubular prolongation may be double or perhaps in greater plurality, arising probably from there being more than one hilous aperture on the statoblast, which is not unfrequently the case (fig. 10, *e*, *h*); and so on, endlessly; but the foregoing instances are sufficient for our purpose.

Nothing can be more opposed to the advancement of natural history than burdening it with species which involve subsequent contradiction, as nothing is more true than that the impression of "bitter words" once spoken can never be entirely effaced; after which, to myself, nothing is more pusillanimous than assigning functions to developments which speak for themselves, as if Nature could not do without them. Hence I have only alluded to the "office" of the cirrous appendages on the statoblast of certain species of *Spongilla*, which seems to me so plain that a child could point it out; yet if we were asked, why they are not in all species of *Spongilla*, or on the statoblasts of all species of freshwater Polyzoa, or why the "Galloway breed of cattle" has no horns, it is not improbable that either question would be met with an "opinion" which is more a matter of faith than of scientific inquiry.

Thus, as Noiré states in Max Müller's translation of Kant, "Imagination is the greatest foe to true knowledge."

As regards the general description and the spiculation of the species of *Spongilla* which Mr. Potts has found in the State of Pennsylvania (to which may be added one of *Tubella* from the Schuylkill river, just received), some of which do and some do not bear the cirrous appendages, it is to be hoped that one and all will be fully published with illustrations, as the paucity of our information on the subject can ill afford to lose a contribution like that which the indefatigable researches of Mr. Potts, in one of the richest localities of the world for *Spongilla*, have enabled him to supply. Why I have apparently usurped a description of the cirrous appendages will have been made known by the above.

Lastly, I would advert to *Spongiophaga communis* (one of the many developments which, in these days of accounting for every thing, has not been accounted for). What is it? and whence does it come? Abundant and common in *Hircinia*, as before stated, "as the grass of the field," replacing every part of the sponge but the inorganic skeleton so accurately and so completely that at first sight it is impossible to consider it otherwise, and yet so insidiously that it looks like a transformation, I still cannot help thinking that, although we cannot identify the cirrous appendages of the statoblasts in *Spongilla* with it, yet they bear such a great resemblance to *Spongiophaga communis*, especially in *Carterella tenosperma*, that there is something analogous in the two growths, whatever this may turn out to be hereafter. It therefore must not be thought that because I have been obliged, through further information, to abandon the generic appellation *Spongiophaga* for the cirrous appendages, I shall rest with their discovery in *Spongilla*, any more than I did when at first they appeared to me to throw some light on the nature of *Spongiophaga communis*.

EXPLANATION OF PLATE XIV.

N.B.—Figs. 2, 3, and 7–9 are drawn to the same scale, viz. 1-48th to 1-1800th inch, in order that the relative size of their several parts may be at once realized.

Fig. 1. *Carterella latitenta*, Potts. Two statoblasts with their cirrous appendages, one bearing a single and the other a double cirrus. About the natural size. Statoblast 1-48th inch in diameter, cirrous appendage about one third of an inch long.

Fig. 2. The same. Cirrus single. Magnified upon the scale above mentioned. *a*, germinal contents of statobast; *b*, membranous envelope of the same; *c*, chitinous coat (indicated by the dark line); *d*, spiculiferous coat (indicated by the dotted line); *e*, mamil-

liform process of b; f, tubular prolongation of the chitinous coat; $g\,g\,g$, cirrous appendage; $h\,h\,h$, larger cord-like margin of the same, ending in the free termination i; $k\,k$, smaller cord-like margin, ending in the free termination l; $m\,m\,m$, ribbon-like expansion or chitinous membrane between the cord-like margins.

Fig. 3. The same. Cirrus double. Letters a to h, inclusive, indicate the same parts as in fig. 2. $k\,k$, ribbon-like expansion between the cord-like margins; $l\,l$, ends of the cirri, broken off.

Fig. 4. The same. Tubular prolongation, more magnified, to show supernumerary cirri in an incipient or bud-like state. a, tubular prolongation; $b\,b$, double cirrus with the ends broken off; $c\,c$, ribbon-like expansion between the cord-like margins; $d\,d$, broken ends of the cirri; $e\,e$, incipient cirri. Scale about 1-48th to 1-6000th inch.

Fig. 5. The same. Free end of cirrus, showing a branched, anastomosing form. Variety.

Fig. 6. *Pectinatella magnifica*, cirrus of statoblast of, much magnified, to show axial line of particles. a, portion of cell-coat or float of statoblast; b, cirrus; c, head and terminal branches; d, axial line of particles. Scale 1-48th to 1-6000th inch.

Fig. 7. *Carterella tubisperma*, Potts. Letters a to f, inclusive, the same as in fig. 2. g, membranous disk round the free end of the tubular prolongation, giving off five minute cirri.

Fig. 8. The same. Membranous disk, giving off ten minute cirri. Variety.

Fig. 9. The same. Membranous disk and cirri double, one a little below the other, each giving off several minute cirri. Variety.

Fig. 10. The same. Statoblast giving off two tubular prolongations. Letters a to g the same as in fig. 7. i, additional tubular prolongation; $e\;h$, mamilliform projections of b; d, remains of spiculiferous coat.

XLII.—*Undescribed Rhapalocera from the Malay Peninsula.* By W. L. Distant.

Ypthima Newboldi, n. sp.

Wings above pale brown. Anterior wings with a large subovate paler fascia, placed transversely on apical half, and on which is a large black ocellated spot, with a yellow margin and with two small bluish talc-like eyes; this spot is placed a little beyond end of cell, its upper margin extending a little above first discoidal nervule, and its lower margin reaching the second median nervule. Posterior wings with a broad pale submarginal fascia, on which are three ocellated black spots, with yellow margins and bluish talc-like eyes, the first and smallest of which is placed between second subcostal and discoidal nervules, and the other two, which are largest and placed close together, are situated nearer to the posterior

margin and between the median nervules. Underside of wings pale greyish, mottled with brown; ocellated spots as above, but posterior wings having two additional smaller ones placed close together near anal angle, between third median nervule and submedian nervure and the small spot, as seen above, much larger beneath.

Expanse of wings 40 millim.

Hab. Province Wellesley.

Allied to *Y. methora*, Hew., but differs in having five instead of six ocellated spots on the underside of the posterior wings, which have also a different and more unicolorous hue.

Elymnias discrepans, n. sp.

Male. Closely allied to the male of *E. undularis*, but smaller, with the rufous margin to posterior wings narrower and more obscure.

Female. Differing much from the same sex of *E. undularis*, smaller in size, the basal ochraceous shading to anterior wings above less in area, the subapical and submarginal spots smaller, blue instead of white, and placed much nearer outer margin. Posterior wings above fuscous, becoming more or less dull ochraceous on disk, and with a submarginal pale but obscure spot placed between discoidal and median nervules. Wings beneath pale testaceous, mottled with castaneous, with a very broad, regular, and paler outer margin to both wings; anterior wings with a large, pale, angulated patch on costa near apex, from which to base are scattered some small pale costal spots; posterior wings with a white spot between first and second subcostal nervules.

Expanse of wings, ♂ 60 to 68 millim., ♀ (one specimen) 60 millim.

Hab. Province Wellesley; Penang.

This is clearly a constant race of *E. undularis*, differing principally and strongly in the female sex. As other races of this species have received specific names, it becomes necessary to treat this form in the same manner.

XLIII.—*On a Case of complete Abortion of the Reproductive Organs of* Vitrina. By F. d'Arruda Furtado*.

In the month of February 1881 I collected ten specimens of a species of *Vitrina* upon bunches of heather on the mountains of Ladeira do Ledo, near 7 Cidades, in the island of St. Mi-

* Translated and communicated by Prof. L. C. Miall.

chael's, one of the Azores. These *Vitrinæ* were readily distinguished by their more vivid colour from the species which I had previously found in the island, and which are recorded by M. Morelet as occurring there. The shell resembles in its greenish tint, its dimensions, and its generally globular form that of *V. mollis*, which Morelet and Drouet found in Terceira only.

I lost no time in dissecting one of the specimens, being anxious to compare the organs of generation with those of other species; but as soon as I had laid open the neck of the animal I was greatly surprised to find that the organs which I looked for were altogether absent. My curiosity being excited, I dissected in succession seven specimens; but in none of these could I find the least trace of reproductive organs.

The ten examples agreed in colour, outward appearance, and internal structure. Differences of size were observed; and in some the shells were less inflated than in others. From the size of the shell I infer that the individuals were of about the same age; and as they were all found close together, they probably belonged to one brood.

It seems to me improbable that ten individuals, the offspring of parents belonging to one and the same species, would offer so remarkable and regular an anomaly; and I am therefore inclined to think that these *Vitrinæ* are hybrids. Possibly the conditions of life in the Azores may be favourable to hybridity among terrestrial Gasteropoda. M. Morelet mentions a *Bulimus* intermediate between *B. pruninus* and *B. vulgaris*, which was found in St. Michael's; and he adds, "on ne trouve d'autre explication à cette singularité qu'une alliance adultérine entre les deux mollusques" *. M. Drouet cites the shell of a mollusk, found at Santa Maria, living side by side with *Zonites volutella* and *Z. miguelinus*, which agreed with the former in colour and with the latter in shape †. I have not been able to procure examples of either of these mollusks for anatomical examination. Probably they were sterile hybrids and have left no descendants.

The mandible and lingual ribbon of the asexual *Vitrina* agree perfectly with those of *V. brumalis*, the only species which I have been able to study. Before describing the shell, I submit a Table of all the Azorean *Vitrinæ*, according to shell-characters:—

1	Right margin of peristome reflected	*finitima.*
	Right margin of peristome not reflected	2

* 'Notice sur l'hist. nat. des Açores,' pp. 186, 187 (1860).

† 'Eléments de la faune açoréenne,' p. 426 (1861).

2	Last spire angulated	*angulosa.*
	Last spire not angulated	3
3	A columella	4
	No columella	5
4	Shell helicoid, globular	*pelagica.*
	Shell slightly globular; the last spire elongated......	*laxata.*
5	Shell globular, resembling a young *Helix*............	*mollis.*
	Shell depressed	6
6	Three spires in the shell, "*ultimus magnus*"	*brumalis.*
	Two and a half spires in the shell, "*ultimus permagnus*"..	*brevispira.*

The asexual *Vitrinæ* belong to sections 5 and 6, and are nearly allied to *mollis*, *brumalis*, and *brevispira*. The three species recorded from St. Michael's are *laxata*, *brumalis*, and *brevispira*; and we should therefore expect that the asexual mollusks, if really hybrids, would be the offspring of *brumalis* and *brevispira*. At first sight, however, they resemble most closely neither of these, but *mollis*, a species hitherto unknown in the island. It is, of course, possible that *mollis* occurs there but has been overlooked. I have not been able to find any sexual *Vitrina* in the neighbourhood of Ledo, except *brumalis*.

Quite recently I have revisited the spot expressly to search for more neuters; but the search was unproductive.

Ponta Delgada, July 15, 1881.

I have dissected two of the three *Vitrinæ* sent over by Mr. Furtado, without finding any trace of reproductive organs. The parts are usually very voluminous in snails, and it is not easy to make a mistake as to their presence in a normally developed animal. In order to investigate the point more carefully, the third specimen was cut into transparent slices and compared microscopically with similar sections of *Helix aspersa*; but no reproductive organs were found. The multitude of details revealed by the microscope makes it difficult to speak confidently as to the complete absence of any structure which is not recognized; and I rely upon the simple dissections more fully than upon the microscopic examination.

Abortion of the reproductive organs has been observed in animals infested by parasites, *e. g.* in stylopized bees, in *Lymnæa stagnalis* when attacked by Trematodes, and in female hermit-crabs attacked by Rhizocephala. The complete abortion of the parts in the remarkable case described by Mr. Furtado distinguishes it at once from the many cases of real or supposed functional defect met with in hybrids.—L. C. M.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

March 8, 1882.—J. W. Hulke, Esq., F.R.S., President, in the Chair.

The following communication was read:—

"On the Crag Shells of Aberdeenshire and the Gravel Beds containing them." By Thomas F. Jamieson, Esq., F.G.S.

The author, in 1860, described beds of sand and gravel on the coast of Aberdeenshire, containing numerous fragments of Crag shells. His subsequent studies have enabled him to throw much further light on these shells and their mode of occurrence. The deposits containing the shells are almost wholly confined to the districts of Slains and Cruden, and extend up to heights of 225 feet above the present sea-level. They generally consist of coarse gravel with large subangular stones up to 2½ feet in length, intermixed with sand and muddy materials; the whole form ridges, like eskers or moraines, though glacially striated blocks are rare in them. The author describes the coast-section in detail, and shows that the shell-bearing gravels rest on materials that appear to be formed by glacial action and are covered by the Red Clay which he regards as having been formed during the period of great submergence. The few entire shells are filled with a calcareous matrix; and fragments of the same material are found scattered in the gravel and sand. This lends support to the conclusion adopted by the author, that the sand and gravel have been accumulated by a glacier moving over preexistent Crag deposits. Among the shells found, 21 could be specifically determined; and of these 67 per cent. occur in the Coralline Crag, 95 per cent. in the Red Crag, and 57 per cent. are living species. Only one species (*Tellina balthica*) occurring in the Aberdeenshire deposits is not found in the English Crags.

March 22, 1882.—J. W. Hulke, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "On a Fossil Species of *Camptoceras*, a Freshwater Mollusk, from the Eocene of Sheerness." By Lt.-Colonel H. H. Godwin-Austen, F.R.S., F.G.S.

In this paper the author described a new species of fossil mollusk from the upper part of the London Clay, near Sheerness, where it was discovered by Mr. W. H. Shrubsole. He referred it to the genus *Camptoceras*, Benson, a recent freshwater type, hitherto known only from three species found in widely separated localities in India by different naturalists. The genus has a sinistrorse shell, with

disunited whorls; and the species, which the author named *Camptoceras priscum*, is elongate, with the apex very acuminate and slightly curved, and consists of four whorls rather rapidly increasing and constricted at intervals, then becoming tumid. The surface shows slight indications of spiral ribbing in the casts. The aperture is not distinctly shown, but was evidently oblique, circular or oblate, and slightly reflected. The length of the shell was about a quarter of an inch. Numerous specimens were obtained in a single fragment of clay.

2. "Note on the Os Pubis and Ischium of *Ornithopsis eucamerotus* (synonyms—*Eucamerotus*, Hulke; *Bothriospondylus* (in part), R. Owen; *Chondrosteosaurus*, R. Owen)." By J. W. Hulke, Esq., F.R.S., Pres.G.S.

In this paper the author reviewed the various contributions to the knowledge of this Dinosaur, for which he adopted Prof. Seeley's generic name *Ornithopsis*, employing the name *eucamerotus*, originally applied by him to the genus, as the specific name. He also discussed the affinities existing between *Ornithopsis* and certain other Dinosaurs, such as *Cetcosaurus* and the American genera *Camarasaurus*, *Atlantosaurus*, and *Brontosaurus*. He then described the pubis and ischium which have recently been acquired by the British Museum from the collection of the late Rev. W. Fox, by whom they were purchased, together with the finest typical thoracic vertebræ of *Ornithopsis*. The pubis was described as an oblong, flattened, nearly straight bar, about 11 inches wide in the middle and broader at the two ends, with an oval foramen in the acetabular dilatation of the proximal part, which unites by a straight suture with the anterior dilatation of the ischium; the latter is narrower, stouter, and more curved than the pubis. The length of the pubis is about 29 inches, and that of the ischium about 26 inches. At the proximal end of the ischium there is a posterior process which united with the ilium and formed the posterior boundary of the acetabulum, the inner border of this and the posterior part of the proximal surface of the pubis forming a common curve belonging to the acetabulum. The author compared the arrangement to that found in *Atlantosaurus immanis*, Marsh.

3. "On *Neusticosaurus pusillus* (Fraas), an Amphibious Reptile having affinities with the terrestrial Nothosauria and with the marine Plesiosauria." By Prof. H. G. Seeley, F.R.S., F.G.S.

These remains come from the Lettenkohle, a stratum between the Upper Muschelkalk and Keuper, and were obtained at Hoheneck, about 9 miles north of Stuttgart. They have been already noticed by Dr. Fraas under the name of *Simosaurus pusillus*; but the palate differs much from that of this genus, and from all others that are known. *Neusticosaurus* is the smallest representative of the Plesiosauria yet known, and has a special interest as exhibiting hind limbs with the characteristics of a terrestrial animal, while the

fore limbs are modified into paddles. Two specimens have been obtained. The extreme length of the skeleton of the larger is about 270 millim.; and, with the exception of the abdominal ribs and some parts of the pelvic girdle, it is perfect. The author described minutely the various parts of the skeleton, concluding with some remarks on the affinities of the Crocodiles with the Plesiosaurs. *Neusticosaurus* indicates that the latter had ancestors which were terrestrial in habit.

BIBLIOGRAPHICAL NOTICE.

Aid to the Identification of Insects. Edited by CHARLES OWEN WATERHOUSE. Lithographs by EDWIN WILSON. London: E. W. Janson.

THE first volume of this work, to the earlier numbers of which we called attention last year in the March number of the 'Annals,' is now complete. Of the 100 plates, 85 have been taken from the type specimens, lent for the purpose by their possessors, of whom a list is given. Mr. Waterhouse has also supplied short notes on many of the species, and two indexes, the one systematic and the other alphabetical. With few exceptions, the insects figured are remarkable either for their beauty or for their peculiar form and structure. One of the most singular is *Apoderus tenuissimus*, with a neck more than double the length of its body. *Plectogaster pectinicornis* and *Cyclopeplus cyaneus* are two curious longicorns. The Neuroptera are admirably figured; but by omitting the legs the effect of the handsome *Ascalaphus Ramburii* is considerably impaired. Compare this with *Helcopteryx rhodiogramma*, and the difference is obvious. The Lepidoptera, represented in twenty-nine plates, are not so striking (considering the marvellous beauty of some of the order) as might be expected. One, however, with its enormously long-tailed hind wings (*Eudæmonia argiphontes*) is an exception. Diptera and Orthoptera have each one representative; both orders, especially the latter, abound in remarkable forms. In the next volume we shall be glad to see some of them represented by so excellent an artist as Mr. Wilson.

MISCELLANEOUS.

CHARLES DARWIN.

IN the face of the many and often admirable eulogia of Charles Darwin that have appeared in nearly all languages during the last few days, we feel that to add to their number is in some degree a work of supererogation; but we cannot refrain from offering our tribute of respect to the memory of the illustrious naturalist who

has so lately departed from among us. And we feel that it is the more incumbent upon us to give expression to our profound feeling of regret at the loss which the whole scientific world has just sustained, as we were at the first opposed to the doctrines put forward by Mr. Darwin, and have never been among the uncompromising supporters of the special form of the theory of evolution which was embodied in the 'Origin of Species.'

Of the character of his writings it is unnecessary for us to speak. Those who are capable of appreciating them know well how brilliantly the genius of true scientific investigation shines forth from every page; how marvellously all details are brought together that bear upon the subject under consideration; how the minutest points are seized and their indications followed until they lead to most important results; how patiently and carefully lines of experimental research are pursued; how every fact that seems to make against the author's views is candidly and conscientiously stated, often much more strongly than they could have been by his opponents themselves; and, finally, how grandly, and yet how cautiously, the enormous mass of facts accumulated is generalized. These qualities of his work must in time have brought about a change in the sentiments of the public towards Darwin and his opinions; but the amount of prejudice with which they had from the first to contend, rendered still more violent by the injudicious course taken by some of his followers, makes it truly a matter of wonder that the merits of the man and the value of his labours should have met with such almost universal recognition within so short a period.

One cause of this is no doubt to be found in the personal character of the great naturalist—the modesty and amiability, the extreme conscientiousness and candour which he displayed constantly in his life as in his works. Those of us who had the honour of his acquaintance can bear testimony to the manner in which these qualities came out in personal intercourse, rendering his conversation and correspondence always full of charm. In his writings also we find everywhere the workings of the same admirable qualities; he never attempts to bear down an opponent or to shirk a difficulty; weak arguments are acknowledged to be weak, and he never assumes a thing as a possibility in one page and adopts it as an established fact in the next, "as the manner of some is."

Among naturalists, however, another cause may have operated to bring about the rapid acceptance of the new doctrine. It was impossible for even a staunch believer in the independent creation

of species to read that most remarkable book, the 'Origin of Species,' without feeling that, whether the hypothesis maintained in it were true or false, its perusal had given him a new and broader view of the relations of organisms to each other and to the world at large. In the light thrown on it by the genius of Darwin, systematic natural history assumed a new form; new methods and new purposes of research grew out of the new views; and the investigations of naturalists carried out in accordance with these speedily led to the recognition of the fact that the doctrine of the origin of species by descent with modification, was, if not absolutely true in the particular form given to it by Mr. Darwin, at any rate the best scientific explanation of the observed facts of natural history.

Thus, by his publications of the last twenty-four years, Mr. Darwin, already known as one of the best of English naturalists, has exerted a greater influence upon the study of biology than any one since the days of Linnæus. But this is only the direct result of his labours; indirectly they have changed the whole current of modern thought, and led to a conception of nature and of man himself, the consequences of which are already widely felt in all civilized communities, and will infallibly, in course of time, effect a fundamental change in all our philosophies.

By the influence that he has exerted in this direction, Mr. Darwin will rank, not only as the greatest of English naturalists, but as one of the foremost men of all time; and we cannot but rejoice that the prejudices which for some time prevailed against his views have been so far dispelled as to permit the burial of his remains in the resting-place of those Englishmen whom their country delights to honour. Those who assisted at his funeral will not soon forget the spectacle presented by Westminster Abbey on that occasion.

On a new Apterous Male among the Coccidæ (Acanthococcus aceris, *Sign.*). By M. J. Lichtenstein.

The normal perfect state of the male of *Gossyparia ulmi* is to have only rudiments of wings; and in another Coccid, also of the elm (*Ritsemia pupifera*), the author has indicated that the male is completely apterous. He has also described (Ent. M. Mag. vol. xiv. 1877) an apterous form of male found on the roots of grasses. He now states that the male of *Acanthococcus aceris*, Sign., which is common on the maple, is also apterous. It presents the usual form of the males of the Coccidæ, but shows no trace either of wings or balancers; its length is 0·70 millim., its colour reddish brown; the antennæ are moniliform, of ten joints garnished with hairs, and 0·38 millim. long. The abdomen terminates in an inflated joint bearing

the penis, and placed between two triangular papillæ, from which spring two long white caducous filaments, as in the Coccidæ generally.

The author ascertained the occurrence of these apterous males by rearing them; and he describes their development. The eggs are laid about the 1st of May, and hatched about the 20th to 25th of May, when the young larvæ disperse themselves over the maples, attaching themselves under the leaves and growing very slowly. They are then of an elongate ovoid form, pointed behind and covered with spines, whence the generic name. When the leaves fall the insects make their way to the bark and prepare for their winter sleep, which does not last very long. An enclosed larva in December or the beginning of January is sure to secrete through all its spines, which are really spinners, a felted cottony material which envelops it like a cocoon, closed in front, but transversely cleft behind. The cocoon finished, which is about the 14th of January, the insect casts its skin with the spinning-tubes, which has become useless, and rejects it through the posterior fissure. It then acquires a more elongate form, and appears as a small sac filled with liquid, having, as shapeless appendages, the two antennæ and the six legs, which have scarcely any traces of articulation, and are only 0·009 millim. long. This *pseudonymphal* state lasts a week, when there is a new change of skin, which is again got rid of through the posterior fissure, and the true nymph appears. It has the limbs more developed; the legs are 0·045 millim. in length, and show their articulations very clearly; the antennæ, although smooth and ringed by ten small lines, show by transparence the moniliform antennæ of the perfect insect forming in their interior; in a fortnight the perfect insect bursts this third envelope and rejects it again by the posterior fissure. Then appear the points of the two white filaments secreted by the insect, and which lengthen day by day; finally the elegant little animal escapes backward, runs along the stems of the maples in search of the females, copulates, and dies. It is then the female's turn to surround herself with a cocoon and to fill it with eggs, which will give origin to the next generation.—*Comptes Rendus*, February 20, 1882, p. 499.

Note on Euripus consimilis *of Westwood.*
By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

I have just received from Mr. J. Wood-Mason an interesting paper upon the Lepidopterous genera *Euripus* and *Penthema*, the illustrations to which are admirably faithful.

In this paper Mr. Wood-Mason has been unfortunate enough to fall into error, owing chiefly to the brevity of Westwood's diagnosis of *E. consimilis*. It runs thus:—

"*Diadema consimilis*, Westw., nov. sp.

"Northern India. Coll. East Ind. House.

"*Diadema* alis albis, anticis costa, venis, strigis tribus obliquis limboque apicali nigris; posticis albis, venis anguste, limbo apicali (albo-

maculato) nubilaque transversa abbreviata pone medium, nigris; his subtus ad basin macula parva chermesina notatis. Exp. alar. antic. unc. $3\frac{1}{10}$."

It would be supposed from the above description that the ground-colour of the wings in this species was pure white; the fact that a pure white form does exist in the N.E. Himalayas would convince any Lepidopterist living in India that such was the case. I believe, however, that had Westwood been describing the Darjiling type he would have said "alis niveis" rather than the more vague "albis."

The type of *E. consimilis*, which is now in the collection of the British Museum, is of a yellowish cream-colour, not deep enough for "straw-coloured;" it differs from the white form represented by Wood-Mason in nothing but its yellower colour, in which character it perfectly agrees with its male (*E. hallirothius*). I suspect it to be a dimorphic species; and if so, it would be a mistake to regard the snow-white variety as a local race and give it a distinctive name. In the case of *E. meridionalis*, however, the pattern as well as the colouring ("straw-coloured," W.-M.) differs not a little; and therefore his name will stand for this race.

The yellow colour of Westwood's type is not due to age, but is the tint most prevalent in specimens of *Euripus*; were it caused by time it would be rather stramineous than of the pale creamy-sulphur tint which it is. Moreover, of all the examples which I have seen of this species, in both sexes (and I have seen a good many besides the four yellowish ones in our collection), only one female, obtained from Dr. Lidderdale's series, is, as Mr. Wood-Mason says, "pure and dazzling white."

Descriptions of Spirostreptus *from Madagascar.* By A. G. Butler, F.L.S., F.Z.S., &c.

By a singular *lapsus calami*, I find that I have used the term "nuchal plate" in place of "first dorsal segment" in all three descriptions ('Annals,' April 1882). The "nuchal plate" is a convex and usually elliptical shield between the head and the first dorsal segment, and is present in all the species of *Zephronia* and *Sphærotherium*. It is the part naturally described next to the head; and this may perhaps account for my blunder.

The Alcyonaria of the Bay of Marseilles. By M. A. F. Marion.

The investigation of the Alcyonaria collected by the 'Travailleur' during the expeditions of 1880 and 1881 has led me to prepare a summary of the Cœlenterata of this group, observed by me during the last twelve years upon the shores of Marseilles. The species are numerous; and it seemed to me that the indication of their distribution at the various depths would be an important document

towards the coming investigations. In the present note therefore I shall enumerate the forms captured in our bay in gradually descending from the shore to a depth of 200 metres.

A. *Littoral Zone, including the Meadows of* Posidonia Caulini.—Although the Alcyonaria are not usually littoral animals, we find three species pretty abundantly in the zone that fringes the shore and extends to a depth of 20 metres. These littoral Alcyonaria are of small size, and belong to the family Cornularinæ.

Rhizoxenia rosea, Ph. sp. The corms of this species occur pretty frequently attached to stones a few decimetres under water along the shore of Cape Janet. They are also met with, but more rarely, on the rhizomes of the *Posidoniæ*, at a depth of 15 metres, at some points on the shore of the isle of Ratonneau.

Clavularia crassa, M.-Edw. (*Cornularia crassa*). The *Cornularia crassa* figured in the 'Règne Animal' is a true *Clavularia* without any cuticular covering, but furnished, on the other hand, with an abundance of sclerites. In the Bay of Marseilles *Clavularia crassa* abounds on the rhizomes of the *Posidoniæ* of the creek of Ratonneau at a depth of 2 or 3 metres. Some corms of the same species not bearing more than three or four zooids, and presenting only a pale tint, have been observed at much greater depths (110 metres) attached to fragments of shells, beyond the bay, to the south of the Isle of Riou. The reproduction of this species takes place in June. The male colonies differ from the female in the length and slenderness of the polypes. The ova, enveloped in a rather dense mucus, are borne at the extremity of the zooids, after the fashion of the ova of *Dasychone lucullana*. It was upon this species that Kowalevsky and myself in 1879 observed a very distinct total segmentation, the formation of a planula, and the histological differentiation of an ectodermic pseudomesoderm, not passing through the stage of a cellular blastodermic lamella.

We have no zoological information as to the Neapolitan *Clavularia* named *C. ochracea* by G. von Koch (Morph. Jahrb. vii. livr. 3, 1881). This Alcyonarian perhaps does not differ from the one here cited.

Cornularia cornucopiæ. This species is easily recognizable by its little cornets secreted by the ectoderm, and resembling the protective tubes of the *Tubiporæ*. In the Bay of Marseilles it is associated with *Clavularia crassa*; but it is always rarer, and does not appear to quit the meadows of *Zostera*.

B. *Muddy and Sandy-muddy Zone beyond the* Zosteræ.—The meadows of *Posidoniæ* are sometimes margined by mud or muddy sand, sometimes by coralligenous gravels. The muddy spaces abound particularly in the north-western region of the bay; and there the depths vary from 30 to 80 metres. The Alcyonaria hold an important place in the fauna of these stations.

Alcyonium palmatum, Pall. Very abundant. All the corms belong to the typical form, the base of which is produced into a long peduncular stalk, destitute of zooids, and buried in the mud. It was collected in the Bay of Biscay in 1880.

Veretillum cynomorium, Pall. Does not quit the muddy bottoms. Frequent near the Ile de Maire and the Goudes at 18 and 20 metres. Descends to 80 metres in the north-western region, towards the mouths of the Rhone. Taken in the Bay of Biscay.

Pteroides griseum, Bob. The most abundant Pennatulid on our coasts. Inhabits the mud of the north-west, outside the isles of Ratonneau and Pomègue (60–80 metres). Some individuals penetrate into the sandy mud to the south of Pomègue. The two varieties, *brevispinosa* and *longispinosa*, are represented; but the second is the more frequent.

Pennatula rubra, Ell. Much rarer than the preceding.

Pennatula phosphorea, L. Very rare in the regions of *Pteroides griseum*.

Leptogorgia viminalis, Pall. The muddy and sandy-muddy bottoms are not the ordinary stations of the Gorgonias; but along the north shore, from L'Estague to Méjean, we find, at 40, 50, and 70 metres, a Gorgonia with slender branches, which I identify with *Leptogorgia viminalis*. It is attached sometimes to the shells of *Pectunculi*, sometimes to stones or to tiles dropped from the lighters of Saint-Henry. The branches are sometimes very long and not much ramified, drooping; in other cases the polypary is more spread out, like a fan.

Gorgonia graminea, Lam. Very rare. A few small polyparies, scarcely ramified, are associated with the *Leptogorgiæ*.

Sympodium coralloides, Pall. On *Leptogorgia viminalis*.

C. *Zone of Gravels, Sands, and Coralligenous Submarine Rocks.*—From 30 to 70 metres. Shores of the isles Pomègue and Ratonneau. Submarine rocks off Montredon. Deep reefs of Mangespeu. Around the *Zosteræ* at Carry, Podesta, and Riou. Station of Coral and Gorgonias.

Gorgonia graminea, Lam. Very abundant, and sometimes, especially at Riou, forming very large polyparies.

Gorgonia verrucosa, Pall. Less abundant than the preceding. The sarcosoma is often of a fine yellow colour.

Muricea placomus, Lin. Rare. Coralligenous bottoms of Riou and Podesta.

Corallium rubrum, Costa. Isle of Tiboulen; around Ratonneau. From the Cap Couronne to Carry. Riou.

Sympodium coralloides, Pall.—On all the Gorgonias.

Paralcyonium elegans.—On incrusted Algæ. Ratonneau, off Montredon, Riou. Pretty frequent.

Alcyonium palmatum, var. *acaule*, Marion. This form, which will be considered by some zoologists a true species, I have described in the 'Revue des Sciences Naturelles.' It is characterized by its incrusting base furnished with zooids, and by its dense tissues closely packed with strong spicules.

D. *Muddy Sands of the open Sea, at depths from* 100 to 200 *metres.*—The Alcyonaria diminish rapidly in importance in proportion as we quit the bay and descend towards the great depths. The coral makes its appearance at some rocky points,—for example, to

the south of La Cassidague. *Alcyonium palmatum* is found to the east of Riou, at 90 and 100 metres, in a very fine muddy sand. The specimens belong to the pedunculate form of the muddy bottoms; the tissues, however, are denser. Among the Pennatulids we no longer meet with *Pteroides griseum*: *Pennatula rubra* and *P. phosphorea* alone persist. Some individuals approach the variety *Pennatula phosphorea aculeata*. A variety of *Clavularia crassa* sometimes occurs.

It may be as well to remark, in conclusion, that this list, although including fifteen species, does not contain all the Alcyonaria indicated in the Mediterranean. Hitherto we have obtained only fragments of *Mopsea elongata* in the great depths, and we have not yet seen upon our shores *Virgularia*, *Funiculina*, *Kophobelemnon*, or, lastly, *Stylobelemnon pusillus*, which, however, issues from the Mediterranean, and occurs in the Bay of Biscay.—*Comptes Rendus*, April 5, 1882, p. 985.

Alteration of Generic Names.

We have been requested to publish the following alterations of the names of certain genera recently proposed in Capt. Broun's 'Manual of New-Zealand Coleoptera'*, they having been previously used either in that order or in other branches of zoology.

Melanochroa for *Cyclomorpha*.
Geochus for *Geophilus*.
Phorostichus for *Pachyodon*.
Dermothrius for *Pachypeza*.
Hydora for *Pachycephala*.
Inosomus for *Stenopus*.
Priates for *Priatelus*.
Methemus for *Capnodes*.
Acrantus for *Homarus*.
Incentia for *Indecentia*.

On the Development of the Ganglion and of the "Ciliated Sac" in the Bud of Pyrosoma. By M. L. Joliet.

The organ in the Ascidia known as the *vibratile pit*, the *anterior tubercle*, the *olfactory organ*, or the *ciliated sac* consists altogether, as is well known, not only of a vibratile cavity, but also of a canal which follows on it and loses itself, as was first shown by M. de Lacaze-Duthiers, in a glandular mass subjacent to the nervous ganglion.

An olfactory function has generally been ascribed to this organ; nevertheless various hypotheses have been advanced as to its nature;

* This work was reviewed in the 'Annals' for May 1881, p. 412.—Ed.

and finally M. Julien, after describing its structure in various Ascidia with great care, has regarded it, in agreement with M. E. Van Beneden, as representing the hypophysis of the Vertebrata.

The investigations which I have been making for two winters upon the anatomy and gemmation of *Pyrosoma*, some results of which I have already communicated to the Academy, have led me to study the structure and formation of the ganglion and the pit in that Tunicate. It seems to me that the facts that I have been able to ascertain must throw some light on the question.

The ciliated pit or sac of *Pyrosoma* has been very well described by Huxley. According to that author it consists of an elongated canal applied along the median line against the branchial surface of the ganglion, probably terminating cæcally behind, opening in front into the branchial sac by a scarcely dilated orifice, and presenting a small projecting tubercle in its middle region.

I may add that the walls of the canal are formed by a cubical epithelium destitute of cilia, that a few cilia and two or three flagella occur only quite at the entrance, at the point of union with the branchial sac, and that the median tubercle is formed by an aggregation of small rounded cells arranged around a diverticulum of the canal.

The whole organ evidently represents the duct of the gland of the Ascidia; the anterior ciliated part corresponds to the vestibule; and the median tubercle seems to me to represent a rudimentary gland.

In describing the formation of the vibratile pit in the bud of *Pyrosoma*, Kowalevsky expresses himself as follows:—"The wall of the branchial sac forms a small depression, which represents the first trace of the vibratile pit; this pit sinks a little into the ganglion, which consists of an aggregation of cells. *At this period the nervous system has lost its primitive canal-like form*, and consists of an elongated aggregation of rounded cells, in the midst of which we no longer perceive more than a feeble indication of the original cavity." This description, as we shall see, is very far from the truth; for the ganglion, properly so called, does not present a cavity at any moment of its existence, while the primitive neural canal retains its cavity, which is nothing else than that of the ciliated sac.

The section of the very young bud given by the Russian naturalist is correct; and I have been able to ascertain that what he calls the *first trace* [or *rudiment*] of the nervous system, represented at the base of the stolon by a simple train of cells, becomes converted a little later into a canal; the constriction which separates the future zooids from one another finally converts it into a pyriform vesicle.

Does this vesicle afterwards become obliterated to form the ganglion, as supposed by Kowalevsky? By no means; it continues to enlarge for a long time; its cavity dilates and its walls thicken gradually. Subsequently, and in buds which are already advanced, its posterior wall thickens still more, and from it separate some round cells which are placed between the vesicle and the ectoderm. The posterior wall then resumes its original thickness, and remains,

like all the rest of the wall, composed of easily recognizable cubical cells. The rounded cells, now interposed on the outer side, commence an active proliferation in all directions, and quickly form an oval aggregation, which begins to push inwards, towards the anterior wall, the posterior wall of the vesicle, which thus becomes compressed.

The oval aggregation of cells is nothing but the ganglion properly so called, which has only to become enlarged and to extend beyond the sides of the vesicle in order to realize the adult state. As to the vesicle, which always retains its walls in their integrity, and with their histological structure so different from that of the ganglion, it has only to open at the bottom of a slight depression of the branchial sac, which advances towards its superior extremity, in order to constitute the ciliated sac of Huxley.

From this description we see that the primitive nervous canal, the *Nervenrohr*, which was supposed to form the ganglion directly by its obliteration, is nothing but the ciliated sac, the canal of the subnervian gland which gives origin to no nerve; and the ganglion properly so called only proceeds from it indirectly, and only appears at a very late period.

Such are the positive facts that I have been able to ascertain in *Pyrosoma*. What remains for me to say is only an induction which needs to be verified, but which appears to me to be founded upon sound arguments. *Pyrosoma*, notwithstanding its relations with the Thaliaceæ, is, by its general organization, a true compound Ascidian; it is therefore allowable to think that the neural canal observed in the larvæ of Ascidia, and the *cerebral vesicle*, which is only a part of it, may, as in *Pyrosoma*, be merely the rudiment of the canal of the subnervian gland.

This opinion is the more probable because the anterior portion of this canal opens in the Ascidian larva also into the branchial sac, and the ganglion properly so called is formed at its posterior part, although its mode of origin has not been exactly ascertained.

Although we know the origin of the subnervian canal, at least so far as *Pyrosoma* is concerned, we have said nothing of its functions. Without having yet any positive evidence, I believe, with the majority of authors, that it really acts as a sensory organ, and probably an olfactory organ. It may be objected that there is no nerve; but the posterior wall of the canal is applied so directly against the branchial surface of the ganglion, that it is very difficult to assert that some nervous fibrillæ, not longer than the thickness of a cell, do not directly traverse this wall; it is not towards the vestibule that we must seek for these nerves, but at the bottom of the canal, or in the gland, which is perhaps only an organ destined to amplify the sensations.

At any rate, if we have a gland here, its canal is not an excretory duct; for, besides that it is easy to see (as has been done by all authors) that in the living animal the movement of the cilia is directed towards the canal, and not outwards, one can easily ascertain, as I

have done often enough, especially in the *Salpæ*, by diffusing particles of Indian ink in the water, that the current produced by these cilia is also directed towards the bottom of the pit; for all the particles are soon accumulated there.—*Comptes Rendus*, April 5, 1882, p. 988.

The Development of Limulus. By Prof. H. N. Moseley, F.R.S.

Prof. Moseley has published the following note on this subject, with reference to Dr. Packard's paper, reprinted in the present number of the 'Annals':—

In a criticism published in the 'American Naturalist' for April 1882 on Prof. Ray Lankester's recent most able memoir, entitled "*Limulus* an Arachnid," Mr. A. S. Packard, whose most important researches on *Limulus* are familiar to all zoologists, and to whose courtesy I am indebted for a copy of his criticism, after stating other grounds which lead him to differ in opinion from Prof. Lankester as to the close relationship of the king crab and the scorpion, quotes in his final paragraphs extracts from published letters written by my late lamented friend and shipmate, R. von Willemoes-Suhm, from on board H.M.S 'Challenger,' at the Philippine Islands and Japan, in February and May 1875, concerning certain Arthropod embryos which he had had under observation at Zamboangan, and which he then supposed to be the larvæ of *Limulus rotundicauda*. As Von Suhm and I worked together for more than two years daily, with our microscopes within two feet of one another, we naturally discussed all that we did and observed in common, and we frequently talked about these supposed *Limulus* embryos, and looked at them together. It is as well, therefore, since the statements concerning them are being made use of to assist in disproving the position assumed by Prof. E. van Beneden, Prof. Lankester, and others as to the Arachnid nature of *Limulus*, a position of the strength of which I am myself persuaded, that I should state in print that, long before his death, Von Willemoes-Suhm was completely convinced that he had been misled as to the larvæ, and told me that he felt sure they were not those of *Limulus* at all, but belonged to a Cirriped of some sort. I some time ago told my friend, Prof. E. van Beneden, who inquired on the matter, that such was Von Suhm's final conclusion; and I also long ago told Prof. Lankester; and this is no doubt the reason why no reference to Von Suhm's letters was made by the latter in his memoir.

It must be remembered that the only evidence in favour of Von Suhm's *Nauplius* larvæ being those of *Limulus* lay in their general appearance, which simulated to some extent that of an adult *Limulus*, and in the fact that they were caught with the tow-net in Zamboangan harbour, a locality at which *Limulus rotundicauda* occurs.—*Nature*, April 20, 1882.

Oxford, April 15.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 54. JUNE 1882.

XLIV.—*On two new* Muridæ *from Tasmania*. By OLDFIELD THOMAS, F.Z.S., British Museum.

AMONG the considerable collection of Australian Muridæ in the British Museum are the two following new rats from Tasmania, for the first of which I have found it necessary to create a new genus, which I propose to call

MASTACOMYS *, g. n.

Like *Mus*, but with the molars enormously broadened and of somewhat different pattern, and with fewer mammæ.

Mastacomys fuscus, sp. n.

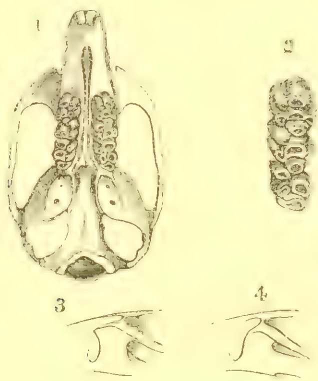
Fur extremely long and soft; general colour dark greyish brown both above and below, the hairs being bluish slate-coloured for the greater part of their length, with their tips light brown above and nearly white below. Ears coloured like the back. Tail and upperside of feet clothed with dark brown hairs, those on the former not lighter below. Skin of both feet and tail very dark-coloured.

Ears rather large; tail shorter than the head and body. Hind feet with the fifth toe reaching just to the base of the

* *μάσταξ*, the chewing-organ, the jaw, from *μασάομαι*, to chew.

fourth. Sole-pads five on the fore feet and six on the hind. Mammæ only four, there being no pectoral and only two inguinal pairs; these latter both quite close to the vulva. Cæcum large, about 3 inches in length.

Skull and incisor teeth of ordinary murine proportions; but the molars most remarkably broad and heavy, the anterior ones each more than half as broad again as the palatal space between them. Their pattern also, as shown in the woodcut (fig. 2), is somewhat different from that of true *Mus*, as there are three cusps to the middle lamina of the first and the anterior lamina of the second tooth only. These third cusps,



which are external, are very small, while the internal ones are unusually large. Third molars remarkably large, as long as either of the preceding teeth. Front edge of the anterior zygoma-root (woodcut, fig. 3) markedly concave. Anterior palatine foramina very narrow, extending backwards to between the middle of the first molars. Supraorbital edges without marked ridges.

For dimensions see below.

The type and only specimen of this interesting form is an adult female in alcohol, presented to the Museum in 1852 by Mr. Ronald Gunn.

It is worthy of note that externally this rat is almost exactly similar to the next species, an animal also from Tasmania, so that an examination of the skull is needed to distinguish the two forms.

The second species is a member of the restricted genus *Mus*, and I propose to call it, on account of the velvety nature of its fur,

Mus velutinus, sp. n.

Fur excessively long, soft, and velvety, almost like that of a Chinchilla in texture. General colour above a peculiar yellowish olivaceous grey, the hairs, which are nearly 1 inch long, being dark slaty grey for nine tenths of their length, with their extreme tips yellow. There are also many longer black hairs intermixed with the others. Belly bluish grey, the bases of the hairs light slate-colour and the tips dirty white. Ears, feet, and tail uniformly dark brown.

Skull rather light and slender, with well-marked supraorbital ridges. Front edge of the anterior zygoma-root slanting in all three specimens, thus differing from all other Australian rats, in which it either projects forward above or is strongly concave below (see woodcut, fig. 4).

Of this species two skins and a skeleton were presented to the Museum in 1877 by Mr. A. Simson.

Dimensions.

	Mastacomys fuscus, ♀ in alcohol.	*Mus velutinus*, adult skins.	
		a.	*b.*
	in.	in.	in.
Head and body	5·60	6·30	5·25
Tail	3·70	4·00	3·45
Hind foot..............	1·22	1·12	1·11
Forearm and hand	1·55		
Ear-conch, length	·68	·63	
Muzzle to ear	1·30	1·38	

Skulls.

	Mastacomys fuscus, type.	*Mus velutinus.* Skull of *b.*	Of the skeleton.
Greatest length..........	1·42	1·34	1·30
Breadth across zygomata..	·84	·71	·68
Length of lower jaw	·98	·88	·80
Nasal bones	·51	·52	·46
Breadth between orbits ..	·17	·20	·21
Anterior palatine foramina.	·30	·25	·25
Incisors to first upper molars	·35	·37	·36
Upper molar series	·39	·30	·29

Besides these two species, the British Museum possesses specimens of two other rats from Tasmania, namely *Mus fuscipes*, Waterh., and a species closely allied to, if not identical with, *Mus lineolatus*, Gould. All four are long-haired rats of about the same size and proportions, with very similarly coloured fur; but they are all readily distinguishable by the

characters of the skull and dentition. *Mus tasmaniensis*, Krefft *, "a new species of land-rat discovered by Mr. George Masters on the banks of the Ouse river," is no doubt one of these four; but even if the type is found to be the same as one of the species here described, Mr. Krefft's name for it cannot stand, as no description whatever has ever been published of it.

XLV.—*Remarkable Forms of* Cellepora *and* Palythoa *from the Senegambian Coast.* By H. J. Carter, F.R.S. &c.

[Plate XVI.]

Cellepora senegambiensis, n. sp. (Pl. XVI. fig. 1, *a–v*.)

Zoarium asteroid, many-armed, about $2\frac{1}{2}$ inches in diameter, with a large hole at the base of the arms (Pl. XVI. fig. 1). Composition calcareous. Structure hard, firm. Colour white, spotted with greenish brown. Consisting of ten cylindrical arms, variable in form, size, length, and position, sometimes bifurcated. Built upon a depressed, turbinoid, littorine shell, over the whole of which—with the exception of the aperture, which is subcircular, about 1-3rd of an inch in its longest diameter, and still remains open (fig. 1, *a*)—the polyzoon has grown. Arms solid, composed throughout of an aggregate of white or colourless cells (zoœcia), heaped together irregularly in the form mentioned, mixed with others of a greenish-brown colour, which, grouped together, retain a radiating (? spiral) arrangement from the axis (which is also composed of the same coloured cells) to the surface (fig. 1, *b'*), where they terminate in subverruciform gentle elevations (fig. 1, *b b*), varying in size from 1 to 2-12ths of an inch in diameter, and disposed more or less quincuncially about the same distance apart, but chiefly collected at the extremity of the arm. Zoœcium conical and erect, or oval and recumbent (fig. 1, *c c c c*); orifice circular, constricted unequally, the smallest part (sinus) posteriorly (fig. 1, *d d d* and *m*), margined by a smooth, round, even rim, bordered in front by two or more tubercles (fig. 1, *l*), and behind by a prominent conical rostrum (fig. 1, *h*), against which the sinus rests more or less perpendicularly (fig. 1, *i*); furnished with a chitinous operculum. Surface of the cell covered with a branched anastomo-

* Fauna of Tasmania, p. 3 (1868).

sing structure in relief, radiating to the circumference (fig. 1, *u*) from the summit of the rostrum, which is thus grooved (fig. 1, *gg*), forming a reticulation whose interstices are respectively perforated by a hole furnished with a circular membranous diaphragm (fig. 1, *v*) ; interstice irregular in size and form, surrounded by three or more tubercles (fig. 1, *s*). Oœcium globular, smooth, overhanging the orifice, which is thus more or less perpendicularized by it (fig. 1, *f*). Avicularia lanceolate, numerous, variable in size, situated in the angular intervals left between the cells (fig. 1, *e e e e e*). Zoœcium in some parts covered with a minute calcareous granulation (? pellicle), especially over the rostrum, not even excluding the chitinous operculum of the orifice (fig. 1, *t*). Size of specimen $2\frac{1}{2}$ inches in diameter from tip to tip of the longest arms; largest arm 1 inch long by half an inch in diameter at the base.

Hab. Marine.

Loc. Coast of Senegambia, West Africa.

Obs. The most striking characters of this species are its asteroid form and spotted surface. Perhaps the colour of the dark parts may arise from an excess of chitine, as it is generally transparent and diffuse. The zoœcia composing them do not appear to differ from the rest, excepting in their prominence and more recumbent position, which, affording the best view of the surface of the cell generally, has been taken for the typical illustration (fig. 1, *c*) ; while those bearing the oœcium (fig. 1, *f*) appear to be confined to the colourless and more erect forms, which, situated in the depressions between the verruciform or coloured portions, are thus most protected. There is, of course, a great variety in the minor detail of the cell, as might be expected in an acervuline mass heaped together irregularly; but the main characters are those above given. Probably the cavity of the shell on which the Polyzoon has grown was once tenanted by a hermit crab (*Pagurus*), which, from the inconvenience of the weight accumulating around him, may have left it to the mercy of the waves, whereby his commensalist perished, and the specimen got to the shore, where it was picked up for preservation. Conjecturing what must have been the size of the *Pagurus*, compared with that of the *shell*, it does not seem unlikely that the burden on the former, or its own increase in size, or both combined, may have led to the desertion. Certain it is, however, that the aperture of the shell would not have been preserved if a *Pagurus* had not taken possession of its cavity, since there is no shell-substance left in contact with the zoarium for some distance inward from the orifice, although

sufficient remains in the interior, as determined by the section of another but inferior specimen, registered 22. 8. 76. 5, to show what the form was.

Palythoa senegambiensis, n. sp.
(Pl. XVI. fig. 2, *a–c*, and fig. 3, *a*, *b*.)

Polypary consisting of four or more stout clumsy arms, bent downwards asteroidly from an arched summit, under which and on one side is an aperture representing that of the shell on which the *Palythoa* had grown (Pl. XVI. figs. 2 and 3). Composition siliceo-arenaceous. Structure subfirm, gritty. Colour light brown. Arm irregular in shape, about 7-12ths of an inch thick in its most cylindrical part, simply rounded at the end (fig. 2, *b*), or expanded and flattened (fig. 3, *b*). Aperture elliptical, about 8-12ths by 3-12ths of an inch in its greatest diameters (fig. 3, *a*). Surface uniformly covered with a great number of papilliform eminences (fig. 2, *a*), more or less in juxtaposition, slightly raised above the common level of the polypary, circular, and about 3-24ths of an inch in diameter, with a 12-plicated aperture in the centre more or less open, leading to a cavity beneath about the same in depth sunk into the polypary, and presenting the remains of at least twelve mesenteric lamellæ; thus the cavity bears the proportion of 3 to 14-24ths of an inch when compared with the thickness of the cylindrical part of the arm, which otherwise is composed of pure sand (fig. 2, *c*). Polyp too much desiccated for description. Size of specimen about $2\frac{3}{4}$ inches from tip to tip of the longest arms; height of the summit of the arch outside about $2\frac{1}{2}$ inches, inside about $\frac{3}{4}$ inch.

Hab. Marine.

Loc. Coast of Senegambia, West Africa.

Obs. Although the branched form of this polypary &c. much resembles that of an *Alcyonium*, yet the arenaceous composition and general appearance is more like that of a *Palythoa*, to which "subfamily" it must be relegated on account of the greater number of mesenteric lamellæ, which, according to Milne-Edwards, "reste toujours à huit chez les Alcyonnaires" ('Zoophytes: Coralliaires,' vol. i. p. 221). From the polyps being only sunk into the polypary so much as to be a little above the general surface, or rather, perhaps, from the latter having risen to this height, it evidently belongs to Milne-Edwards's division "A A A" (*op. cit.* vol. i. p. 305), although a *branched* form is not mentioned. The expanded and flattened ends of the arms of the illustrated specimen (fig. 3, *b*), for there are two very much alike, seem to indicate

that they rested on the ground, while in the other specimen they are all simply rounded, like that of fig. 2, *b*. The same remarks apply to the shell on which the *Palythoa* had built its structure as to that of *Cellepora senegambiensis*, excepting that it appears to have been still more depressed, and, from the smooth shining surface of the portion remaining in the interior, as exposed by a section of the unillustrated specimen, registered 12. 3. 68. 4, together with the elliptical aperture, to have been one of the Naticidæ.

General Observations.

The specimens from which the above descriptions have been taken belong to the Liverpool "Free Public Museum;" and there are two of each, so that I have had one of each to sectionize for the internal structure, while the best of each has been retained entire for illustration, which, together with the sections, will henceforth be returned to the museum for reference. The most remarkable part about them in a physiognomical point of view is that organisms so widely separated in the animal scale should, in the same locality, viz. the Senegambian coast, present the same peculiarities of growth, which, so far, appears not to have been noticed in any other part of the world. There are two specimens of *Cellepora senegambiensis* in the British Museum; and I think that I have seen it figured in some old work, but cannot remember where.

EXPLANATION OF PLATE XVI.

Fig. 1. *Cellepora senegambiensis*, n. sp. Zoarium, natural size. *a*, hole representing the aperture of the shell on which the zoarium has been built; *b b*, coloured portions on the surface; *b'*, section of an arm, showing the same in the interior; *c c c c*, group of cells or zoœcia, with their accompaniments, all magnified on the scale of 1-48th to 1-1800th inch; *dd d d*, orifice; *e e e e*, avicularia; *f*, oœcium; *g g*, rostrum; *h*, front view of rostrum &c., more magnified, viz. on the scale of 1-48th to 1-6000th inch; *i*, sinus of orifice; *k*, orifice; *l*, front part of cell or zoœcium; *m*, orifice and sinus closed by operculum, and *n*, avicularium, on the same scale; *o*, diagram (on the same scale) to show calcareous granulations in *p*, ?-pellicle, on some parts of the zoarium; *q*, surface without the granular growth; *r*, circular diaphragmatic hole in the interstice; *s*, tubercles on the border of the same; *t*, operculum covered with the granular growth; *u*, branched structure in relief on the zoœcium; *v*, diaphragmatic hole in the interstice.

Fig. 2. *Palythoa senegambiensis*, n. sp.: lateral view, with part of upper surface (nat. size). *a*, polyp-cells; *b*, rounded end of arm; *c*, section of the cylindrical part of the arm, to show position and relative size of polyp-cells.

Fig. 3. *Palythoa senegambiensis*, n. sp.: under surface (nat. size). *a*, orifice representing the aperture of the shell on which the polypary has been built; *b*, flattened end of arm.

XLVI.—*Descriptions of new Genera and Species of Longicorn Coleoptera* (Lamiidæ) *from Madagascar*. By CHARLES O. WATERHOUSE.

THE species here described were received from the Rev. W. Deans Cowan, and belong to the same series as the other Longicornia recently described by me in this journal (*antè*, p. 326). They were collected in the neighbourhood of Fianarantsoa.

Lamiidæ.

LASIOCERCIS, n. gen.

General build of *Dichostates*. Antennæ shorter than the body; the first joint elongate, gradually but not much enlarged towards the apex; the third joint scarcely as long as the first, the fourth about the same length as the first, the following joints much shorter. Thorax transverse, with a conical tubercle in the middle of the side, and with two rather acute tubercles on the disk. Elytra oblong, rather depressed at the suture, shoulders nearly rectangular; each elytron with a strongly marked, slightly oblique elevation near the scutellum. Legs stout, the tibiæ with a tuft of hair on the outer edge at the apex. Intercoxal process of the prosternum very broad, arched. Mesosternum rather broader, sloping down.

This genus should be placed next to *Ranova*, with which it agrees in the form of the sterna, but differs in the elongate basal joint of the antennæ, in the curious prominence at the base of the elytra, &c.

Lasiocercis fasciata, n. sp.

Nigra, tomento fere albo dense tecta; antennis, fronte, thoracis disco, elytrorum fascia regioneque scutellari, tibiarum apice tarsisque nigris.

Long. 6 lin.

The bases of the third and following joints of the antennæ are whitish; the joints are beset with few but long black hairs. The thorax has a small round black spot at each anterior angle; the discoidal area (including the dorsal tubercles) is black, with a slight mixture of brown posteriorly; this mixture of black and brown also occupies the space between the basal elevations of the elytra. Near the apex of the elytra there is a broad black fascia, having its basal margin angulated and margined with purer white; there is a small black spot about the middle of the side, and immediately below this, on the disk of the elytron, is a very small raised brown dot,

whence a slight costa commences and extends into the black fascia. The pro- and mesosterna and the abdomen are nearly black.

DIADELIA, n. gen.

Antennæ longer than the whole insect, slender; the basal joint elongate, nearly cylindrical, as long as the length of the thorax; the second and third joints together as long as the first, the fourth joint one third longer than the third, the following joints rather shorter and subequal. Antennal tubercles slightly raised and widely separated. Thorax transverse, angularly enlarged at the middle, and furnished with a strong, not very acute, tubercle; there is a slight swelling immediately behind the anterior angles; and on the disk there are two moderately distinct obtuse tubercles. Scutellum of moderate size. Elytra at the base nearly twice as broad as the base of the thorax, and four and a quarter times the length, gradually but considerably narrowed posteriorly, distinctly flattened at the suture; the lateral margin incrassate and very clearly defined; the apex of each elytron obliquely truncate. Intercoxal process of the prosternum rather narrower and arched. The mesosternum a trifle broader, almost conically produced anteriorly, perpendicular in front. Apical segment of the abdomen flat, trapezoidal, gently emarginate at the apex.

The female has the antennæ only a little longer than the whole insect; in the male they are much longer.

This genus should be placed next to *Amblesthis*, Th., from which the form of the mesosternum will alone be sufficient to distinguish it.

Diadelia biplagiata, n. sp.

Fusca, pube fusca griseaque dense vestita et variegata; elytris pube grisea vestitis, plaga communi basali triangulari et altera laterali fuscis.

Long. $7\frac{1}{4}$ lin.

The mixture of grey and brown pubescence on the underside of the insect and on the legs is about equal; but on the abdomen the grey prevails largely. The grey colour on the head and thorax is less conspicuous; and the antennæ are almost entirely brown. The elytra are pale greyish, with the base brown; and on each elytron, about the middle of the side, is a large brown patch, somewhat trapezoidal in form, but rounded towards the suture; halfway between this and the apex there is a slightly oblique dusky line; there is a line of pale brown dots along the suture; and a little way removed from the suture another similar line may be traced,

but the dots are smaller; the basal region is strongly but not very closely punctured, and there are also numerous minute black punctures traceable over the surface. The antennæ are sparingly beset below with rather long hairs. The surface of the thorax is uneven; on the disk, rather in front of the middle, are two obtuse slightly raised tubercles; and behind these a third one, much less distinct, may be traced in the middle.

The above description is taken from the male. The female example is rather more uniform grey; the brown at the base of the elytra is scarcely visible; and the dusky line near the apex is wanting.

Lepturidæ.

Dysmathosoma, n. gen.

Head as broad as long, rather flattened; muzzle extremely short; eyes rather prominent laterally, coarsely granular, slightly emarginate in front, not supported posteriorly by the cheeks; antennal tubercles slightly raised, widely separated. Antennæ robust, reaching rather beyond the middle of the elytra, situated considerably in front of the eye; the basal joint moderately elongate, thick, slightly bent, much narrowed towards the base; the second joint small and transverse; the third and fourth subequal, nearly as long as the first, but more slender; the fifth to ninth joints subequal, all distinctly longer than the fourth *. Thorax scarcely broader than long, slightly constricted immediately behind the anterior angles, with an obtuse not very prominent tubercle at the side, rather in front of the middle; behind this the sides are parallel; disk with two oblong-ovate swellings rather before the middle, and smaller round ones at the base. Scutellum moderately small, triangular. Elytra at the base twice the width of the front of the thorax, gradually but not much narrowed posteriorly, flattened on the back, rounded at the apex. Intercoxal process of the prosternum very narrow, so that the coxæ are nearly contiguous posteriorly, arched. Mesosternum not very wide, sloping in front. Metathoracic parapleura moderately broad at the base, gradually acuminate posteriorly. Abdomen with the apical segment rather flat, triangularly notched at the apex. Legs very robust; the femora very thick, somewhat narrower towards the base, rather suddenly emarginate below at the apex. Tibiæ somewhat enlarged at the apex; the middle pair with two strong spurs at the apex; in the posterior pair one of the inner

* The tenth and eleventh joints are wanting in the specimen described.

angles is produced into a spur-like process; the other inner angle is furnished with an acute spur.

I think this genus must undoubtedly be placed among the Lepturidæ, although it is quite unlike any thing in that family known to me. The structure of the antennæ is nearest to that in *Rhamnusium*, but the joints are all rather longer; the structure of the sterna and abdomen also agree well with that genus, except that the prosternal process is more sloping posteriorly. The eyes, however, are very finely granular, and are not supported posteriorly by the cheeks, in which characters it agrees with some other Madagascar Lepturidæ; and, on the whole, it appears to be best placed near *Enthymius*, Waterh.

Dysmathosoma picipes, n. sp.

Nigrum, parum nitidum, brevissime griseo-pilosum; antennis pedibusque rufo-piceis; elytris piceis sublævibus, vitta impressa discoidali et altera apicali griseo-pubescentibus.

Long. $10\frac{1}{2}$ lin.

The head is closely and very finely punctured. The thorax is smooth, except along the front margin and in the space between the dorsal swellings, where it is closely and very finely punctured. The elytra are smooth and shining, with a few punctures scattered over the surface; there is a slight impression at the base within the shoulder; on the disk near the suture is an elongate narrow impression, and at the apex there is another similar impression, but shallower. The surface may perhaps be at times entirely clothed with greyish-white pubescence; but in the specimen described it is only in the impressions. The metasternum has a deep impressed median line; it is, as well as the four basal segments of the abdomen, sparingly punctured; the apical segment is more thickly and more finely punctured.

XLVII.—*Description of a new Species of* Mantidæ. By Francis P. Pascoe.

Callimantis eximia.

C. capite prothoraceque sordide luteis, tegminibus fulvo-viridibus; alis antice miniatis, postice purpureo-fuscis, albo-venosis, extus pellucido-limbatis. Long. 10 lin.

Hab. Pará.

Head and prothorax dull fulvous, the latter about half as long again as the breadth of the head; antennæ very slender,

black; tegmina fulvous green; wings with a pellucid border gradually narrowing posteriorly, the anterior quarter miniaceous red, the remainder purplish brown (except that at the base there is a reddish tinge), the veins white; abdomen dull yellowish, glossy; legs greenish, anterior coxæ paler.

In the British Museum this elegant little species bears the MS. name *C. venezuelæ*, Bates; but, as it is now shown to extend beyond Venezuela, I have not adopted that name. I took a single specimen by sweeping among some low bushes in a *naturally* open space probably a mile or so long, and about half that breadth, with the primæval forest all around, a mile or two beyond the little village of Nazaré, near Pará; but, although I returned to the spot several times, I never succeeded in finding another.

This species will be figured in an early number of 'Aid to the Identification of Insects.'

XLVIII.—*Note on the Classification of the Homoptera.* By Francis P. Pascoe.

Considerable difference of opinion exists as to the relative value of groups below the rank of orders among the Insecta; and nowhere perhaps is it more remarkable than with the Hemiptera *. Entomologists in the middle ages, *i. e.* from about 1830 to 1860, were content to divide the Homopterous section of them, exclusive of the Phytophthiria or Sternorhynchi, into three families, while the Heteropterous section had eleven (Amyot and Serville, 1843). Now we have at most five families of the former; but how many of the latter I am not prepared to say, Messrs. Douglas and Scott, in their 'British Hemiptera-Heteroptera' (1865), having not less than sixty-five families for the comparatively few species of these islands alone. For most these so-called families only rank as subordinate groups; but the fact shows how widely opinions differ. In my little work on Zoological Classification (2nd edit. 1880) I proposed thirteen familes † for the

* Hemiptera was one of the four orders into which Linnæus divided the Insecta in the first edition of his 'Systema Naturæ' (1735). Fabricius in 1775 proposed the term Ryngota for the same order (now Rhynchota).

† Wrongly *Cephalelus* and *Ulopa* were placed under Cercopidæ instead of Iassidæ. It is true that this approximation is substantially the same as Walker's (Brit. Mus. List Homop. 637 *et seq.*). *Phenax* seems to lie between Cixiidæ and Lystridæ: *Dictyophora* has the cephalic prolongation of Fulgoridæ.

Homoptera; and as these do not exactly correspond with either the families or subfamilies or tribes of modern writers, I have thought it desirable to throw their characters into a tabular form. It will be seen that the Phytophthiria, including the Aphides, scale-insects, &c. are not here included among the Homoptera. They belong to a lower type, and their habits are very different. Claus, however, is the only modern writer, I believe, who raises them to the rank of a suborder, equivalent to Heteroptera, Homoptera, and Mallophaga. Thripidæ (forming the order Thysanoptera of Haliday) are apparently of higher rank; but they have not in modern times been regarded as a distinct order.

In the Table below I have added parenthetically certain names which are found in books, but which seem to me to be unnecessary.

- Males stridulant, or with a drumming-apparatus (*Stridulantia*) .... CICADIDÆ.
- Males not stridulant.
  - Antennæ inserted below the eyes (*Subtericornes*).
    - Eyes in a cavity of the cheeks (*Cavigeni*).
      - Exterior margin of the tegmina transversely veined (*Strigimargines*) .... FLATIDÆ.
      - Exterior margin of the tegmina not transversely veined (*Nudimargines*).
        - Head prolonged anteriorly .... FULGORIDÆ.
        - Head not prolonged.
          - Pro- and mesothorax together rhombiform .... ISSIDÆ.
          - Pro- and mesothorax not rhombiform.
            - Antennæ elongate, passing beyond the cheeks .... DERBIDÆ.
            - Antennæ not passing beyond the cheeks.
              - Anterior wings transparent .... CIXIIDÆ.
              - Anterior wings not transparent.. LYSTRIDÆ.
    - Eyes not in a cavity of the cheeks (*Planigeni*) TETTIGOMETRIDÆ.
  - Antennæ inserted in front of the eyes (*Antericornes*).
    - Prothorax prolonged above the abdomen (*Cornidorsi*) .... MEMBRACIDÆ.
    - Prothorax not prolonged (*Planidorsi*).
      - Posterior tibiæ with a double row of spines (*Serripedes*).
        - Ocelli situated on the anterior part of the head .... IASSIDÆ.
        - Ocelli more or less on the vertex.
          - Body elongate .... TETTIGONIIDÆ.
          - Body broadly ovate.......... LEDRIDÆ.
      - Posterior tibiæ without a double row of spines (*Lævipedes*) .... CERCOPIDÆ.

XLIX.—*The Sponge-fauna of Norway; a Report on the Rev. A. M. Norman's Collection of Sponges from the Norwegian Coast.* By Prof. W. J. SOLLAS, M.A., F.R.S.E., &c.

[Plate XVII.]

[Continued from p. 165.]

Tetilla cranium (continued).

Before proceeding to the description of the next sponge it will be necessary to add, by way of appendix, a few words on the generic designation of this species. I had indeed hoped that its title *Tetilla* was inalienably joined to it; but unfortunately that is not the case, since it is not the type of the genus. This place is occupied by *T. euplocamus*, O. S., on which, in in 1868, the genus was founded. This species, indeed, enjoys a name which cannot be changed, but not *T. cranium*; let any difference of generic importance be discovered between it and the type, and *T. cranium* must find a new generic name. The existence of such a difference has already been proclaimed by O. Schmidt, who regards the possession of anchoring filaments by *T. euplocamus*, *polyura*, *radiata*, and *submersa* as a generic character, uniting them together, to the exclusion of *T. cranium*. As a matter of course, *T. cranium* should receive a new generic name; but, as a matter of fact, the new name has been found for the type and its congeners, while the old one is retained by the residual *T. cranium*.

Whatever special advantages this plan may possess are counterbalanced by its contravention of a recognized custom, and its consequent tendency to throw our nomenclature, which is based on recognized custom, into confusion. The oftener general rules are broken the less binding do they become; and the natural result is anarchy. The taunt of being a "purist" in these matters is a reproach to glory in; for till we have the absolute despot, desired by a writer in 'Nature,' to regulate our terminology we shall do well to make the best use we can of an existing substitute; and that is loyal and implicit obedience to those few simple rules which have approved themselves to the general sense of biologists, and of which an excellent summary is given in the 'Stricklandian Code,' published under the approval of the British Association. The practical application of this moral excursus is obviously that *Tetilla euplocamus* should retain its generic name, and if a new one is necessary it should be found for *T. cranium*. But I greatly doubt the necessity; for the

presence or absence of anchoring fascicles appears to me to be of scarcely specific, much less of generic, importance; indeed I have now before me a sponge which in no detail of gross or minute anatomy differs from *Thenea Wallichii* (*Wyville-Thomsonia*), except that it is entirely devoid of the usual appendages. So far as this character goes, therefore, I see no good grounds for separating *Fangophilina* from *Tetilla*, and would therefore reunite them. In that case *Tetilla* (Sollas) would comprise *Tetilla*, Sdt., *Craniella*, Sdt., and *Fangophilina*, Sdt.; but it is quite possible that the distinction between *Tetilla* and *Craniella*, asserted by Schmidt, in the absence of a rind in the former genus, does really exist, and that *T. cranium* has been wrongly included in *Tetilla*, its true place being with *Craniella*. But if *T. cranium* be taken from Schmidt's *Tetilla* there remain only in that genus *T. polyura*, *euplocamus*, and *radiata*, all of which are provided with anchoring tails. By amending the definition of the genus so as to make it include as a character the possession of "tails," all necessity for a new name will disappear, since the residual species of *Tetilla*, left after the removal of *T. cranium*, are just those which Schmidt includes in *Fangophilina*. Thus, if *Craniella* prove distinct from *Tetilla*, we have, on Schmidt's own showing,

Craniella + *T. cranium* = *Craniella*.

Tetilla − *T. cranium* = *Tetilla* = *Fangophilina*.

It only remains to include *Fangophilina submersa* in our list of *Tetilla*, and to add a species of Bowerbank which I had previously overlooked. Continuing from page 161, we have

14. *Tetilla submersa*, O. S. Spong. Meerb. Mexico, 1880, p. 73, pl. x. fig. 3. Carib. Sea.

15. *T. unca*, Bwk. P. Z. S. 1872, p. 118, pl. v. figs. 7–10. Hammerfest, 150 fms.

Tetractinellidæ, Marshall.

Externæ, Sollas.

Leptochrota, Sollas.

Thenea, Gray.

Thenea Wallichii, Perceval Wright.

Synonyms.

1870. *Whyville-Thomsonia Wallichii*, Perceval Wright.
" *Stelletta agariciformis*, O. Schmidt.
" *Dorvillia agariciformis*, Kent.

1871. *Thenea Wallichii*, P. Wright.
1872. *Tethya agariciformis*, Kent.
1873. *Tisiphonia agariciformis* (Kent), Wyville Thomson.

LITERATURE.

(i.) 1858. *Tethea muricata*, Bwk. MS. Phil. Trans. pl. xxv. f. 18.
(ii.) 1862. *Tethea muricata*, Bwk. MS. Phil. Trans. pp. 782, 793, 826, pl. xxxi. figs. 14, 15.
(iii.) 1867. *Thenea muricata*, Bwk., Gray, Proc. Zool. Soc. p. 541.
(iv.) 1869. *Tisiphonia*, n. g., W. Thomson, MS. Phil. Trans. 159, p. 712.
(v.) 1870. *Wyville-Thomsonia Wallichii*, Perceval Wright, Q. J. Micro. Sci. vol. x. p. 7, pl. ii. (January).
(vi.) 1870. *Stelletta agariciformis*, O. Schmidt, Atl. Sp. F. p. . pl. vi. f. 12 (May).
(vii.) 1870. *Dorvillia agariciformis*, Kent, Month. Micros. Journ. p. 293, pl. lxvi. (December).
(viii.) 1871. *Dorvillia agariciformis*, Kent, Ann. & Mag. Nat. Hist. vol. vii. p. 37.
(ix.) ? *Thenea Wallichii*, P. Wright, Zool. Rec. 1870.
(x.) 1872. *Tethya muricata*, Bwk. Proc. Zool. Soc. p. 115, pl. v. figs. 1–6.
(xi.) 1872. *Tethya agariciformis*, Kent, Ann. & Mag. Nat. Hist. vol. x. p. 209.
(xii.) 1873. *Tisiphonia agariciformis*, Kent, W. Thomson, The Depths of the Sea, pp. 74, 167, fig. 7.
(xiii.) 1878. *Tethea muricata*, Bwk., Carter, Ann. & Mag. Nat. Hist. vol. ii. p. 174.
(xiv.) 1880. *Tisiphonia*, W. Thomson, Carter, Ann. & Mag. Nat. Hist.
(xv.) 1880. *Tisiphonia agariciformis*, O. Schmidt, Spong. d. M. v. Mexico.

The nomenclature of this interesting sponge is marked by misfortune more than falls to the common lot. Since it was first described twelve years ago, it has received no less than six different generic and three specific names, has been identified with species generically different from it, and placed in families of strange kin, only to be expelled as an intruder. Its history is bound up with that of another but closely allied species, *Tethea muricata*, with which, as it obtained earlier notice than *Thenea Wallichii*, we shall commence our account. Bowerbank (i.) mentions *T. muricata* as a MS. name in 1858, when describing and figuring its characteristic spinispirules or "elongated stellates," as he termed these flesh-spicules; in 1862 (ii.) he again refers to it, this time adding a figure of its dermal membrane, crowded with spinispirules and reduced to a net-like appearance by the abundant presence of pore-openings; he likewise mentions the presence of bifurcate-ternate spicules with remarkably long and acute rays, which help to form the skeleton-fasciculi, and lie with their heads expanded beneath the skin. The amount of information which Bowerbank thus incidentally accords us of this MS. species is con-

siderable; and it would be a nice point to determine how far, after his published figures and description, it could be regarded as a merely MS. name; into that question I have fortunately no need to enter. That *T. muricata* differs in a marked manner from other described species of *Tethya* is, however, already quite clear; and Gray (iii.), who had a real knowledge of the sponge, so clearly perceived this as to make it the type of a new genus, which he named *Thenea*, and thus defined:—

Fam. 3. TETHYADÆ.

THENEA. Sponge massive.
Spicules:—1. Simple, not protruded beyond the surface.
2. Large, furcate, ternate, with expanded long acute rays.
3. Elongate, stellate, projecting beyond the surface.

Thenea muricata, Bwk. *ib.* i. pp. 25, 108, figs. 35, 304, 305. Norway, Vigten Isl.

In this definition I recognize as correct the statement that the sponge possesses acerate and bifurcate-ternate spicules and elongate stellates—a collocation of forms so different from that which obtains in any other sponge known in Gray's time as to make the generic distinction founded on it a matter beyond dispute. Moreover, lest it should be objected that the genus rests on a MS. species, I would submit first that Gray, by thus bringing together Bowerbank's scattered references and figures, and by adding thereto, as further information, the presence of acerate spicules, did virtually raise *Thenea muricata* from the rank of a MS. to that of a described species; and next, if this be not admitted as a matter beyond question, that there is no reason why, upon occasion, a genus should not be defined before a species. If the particular information which would enable us to define a species be not forthcoming, while the general characters which are available for generic distinction lie ready to hand, there can be no reason, beyond a superstitious adherence to custom (not recognized convention), which shall prevent us making good use of them. *Thenea*, therefore, is a well-grounded generic title applicable to all such sponges as possess a spicular complement like that defined in this connexion by Gray.

Gray's definition is not unmixed truth; thus, we know now, in direct contradiction to Gray's statements, that the sponge is not massive, that some of the acerate spicules do project beyond the surface, and that the spinispirules do not*. Serious as these errors undoubtedl re, they are in no way fatal;

* Or do so only in dried specimens as a consequence of shrinking.

they render it necessary to amend the definition, but furnish no excuse for expunging the name of the genus. If every badly-defined genus were liable to a change of name, systematic zoologists might as well abandon the task of nomenclature altogether.

In 1869, Sir Wyville Thomson (iv.), in his fine memoir on *Holtenia Carpenteri*, founded a new suborder, "Leptophlœa," with *Tisiphonia*, MS., cited as an example. What *Tisiphonia* might exactly be, there was nothing given to show; the name stands as a word of so many letters, and nothing more. We shall find, however, subsequently that an unfounded attempt was made later to turn it into something more; but to this we shall refer in due course: we proceed now to the direct subject of this communication, *Thenea Wallichii* itself.

In 1870, Professor Perceval Wright (v.) gave a full and faithful account of a beautiful little sponge which had been obtained by Dr. Wallich from a depth of 1913 fathoms. This sponge he named, with happy appropriateness, *Wyville-Thomsonia Wallichii*, thus associating the names of the two preeminent deep-sea investigators with the first-obtained species of deep-sea sponge. It possesses the acerates, bifurcate-ternate spicules and spinispirules of *Thenea*, together with large grapnels and some curious few-rayed (one to eight) stellates, not mentioned in Gray's definition. One would thus naturally be led to include it with *Thenea*, were it not for the two forms last mentioned; and we have now to consider whether these afford sufficient reason for generic distinction. If we refer to the value placed on the presence or absence of grapnels in *Geodia* and *Stelletta*, we shall find that they never serve for more than specific distinction; moreover, if it be allowable to go beyond Gray's definition and consult the actual specimen of *Thenea muricata*, we shall find that grapnels are not wanting in it. Then there only remain the pauciradiate stellates; and these alone will not by any one be considered sufficient to distinguish as different genera species which resemble each other in every other important character. Thus, unless some considerable undiscovered difference exists between *Wyville-Thomsonia Wallichii* and *Thenea muricata*, we must be content to regard the former as a fellow species with the latter, and so to name it, as Professor Wright (ix.) himself now asserts it should be named, *Thenea Wallichii*.

Three months after Professor Wright's paper appeared, Oscar Schmidt partly described a similar sponge obtained from a depth of 178 fathoms off Florida; he figured some of its spicules, the grapnels and spinispirules, and named it *Stelletta agariciformis*. A *Stelletta* it certainly is not, as it

lacks the cortex which is essential to that genus; on the other hand, it agrees fundamentally with *Thenea*, and may be called, at this stage of our argument, *Thenea agariciformis*.

Again in 1870, December of that year, Mr. Saville Kent (vii.) described quite independently a sponge in all respects identical with that mentioned and labelled by O. Schmidt. Kent's description is good and fully illustrated, perhaps a little too fully, as he includes certain extraneous sexradiate spicules as proper to the sponge, an error which he was the first to correct (viii.). Kent named his sponge *Dorvillia agariciformis*, choosing, by a quite accidental coincidence, the same character for specific designation as Schmidt had done previously. According to the fortune which seems to wait on nomenclature, we might therefore expect the species would turn out to be different; but, notwithstanding, they are certainly the same.

In the note (viii.) which followed his first paper, Kent states that *Thenea Wallichii* is an embryonic form of *T. agariciformis*, a view accepted by Wright and by spongologists generally. Since, however, Wright's figures of the large few-rayed stellates differ somewhat from those given by Kent, it appeared to me that a loophole was left open for error; and I was led therefore to compare the type specimen of *T. Wallichii* * with Kent's figures and with mountings of the usual agaric form. The result is to show, in a most satisfactory manner, that no sort of real difference exists between the two species: *T. agariciformis* is larger and has a well-marked agaric form with a specialized poriferous area, while *T. Wallichii* is of a globular form and without an evidently specialized poriferous area; these trifling differences are unquestionably due to a difference in age. Though young, Professor Wright's specimen is not embryonic—at least no more so than a child of six is, compared with an adult man. It is considerably advanced in growth; for my smallest specimens of young *Thenea Wallichii* measure only 0·0146 inch in diameter, and this is 0·075 inch, or more than five times as large across.

As Wright's species is certainly a good one, and as it takes precedence of Schmidt's by some three months, that of the latter must, by the most fundamental rule of nomenclature, be suppressed; we then have

Wyville-Thomsonia Wallichii, Wright. *Stelletta agariciformis*, O. S. *Dorvillia agariciformis*, Kent.	} = *Thenea Wallichii*, Wright.

* For the loan of this valuable type my thanks are due and heartily tendered to Mr. C. Stewart and the Council of the Royal Microscopical Society.

We now return to *Thenea muricata*, of which at last, in 1872, Bowerbank (x.) published a full and illustrated description; and so closely in general appearance and in the size and form of its spicules was it found to resemble *Thenea Wallichii*, that Bowerbank declared his conviction that they were one and the same species. His manner of viewing the relations of the two specimens, Kent's and his own, is, however, in the light of further knowledge, somewhat amusing, since he considers Kent's specimen mutilated, the upper portion having, he says, evidently been torn away from the base, causing the part described to assume a form very much like that of an agaric; and he adds that the filiform anchoring appendages have very much the appearance of being some of the skeleton-fasciculi of the sponge drawn out of the basal portion at the time of its mutilation. Kent (xi.), in a "Note on *Tethea muricata*, Bk., and *Dorvillia agariciformis*, Kent," argues against the identification of the two species, resting his case on (1) the agaric form of *Dorvillia* (*Th.*) *Wallichii*, (2) its possession of fascicles of anchoring-spicules, and (3) of quadriradiate flesh-spicules (more correctly pauciradiate stellates). With reference to the first two distinctive characters, I may confess that I do not place great reliance on them: *T. muricata* is not unlike *T. Wallichii* in general form; and the agaric form of the latter is not constant. Some of Mr. Norman's specimens which possess anchoring fascicles and all the spicules proper to the species show no trace of the agaric form; again, the anchoring fascicles, though usual, are not constant. Other of Mr. Norman's specimens with the agaric form and the proper spicular complement of *T. Wallichii* are entirely devoid of anchoring filaments or of any sign of them. The third character cited by Kent is more important: the curious quadriradiate stellates (to be hereafter described) are abundant and characteristic in *T. Wallichii*; and since Bowerbank did not meet Kent's objection by replying that they also occurred in his specimen, we may conclude that they were not present; and hence so far we must admit the specific distinction of *Thenea muricata* and *T. Wallichii*.

In 1873 we again meet with *Tisiphonia*, a passing mention being made of *Tisiphonia agariciformis*, Kent, by Sir Wyville Thomson (xii.) in the 'Depths of the Sea.' The suborder "Leptophlœa" appears to have slipped the memory of its author, as he speaks of the species he had given in its illustration as "that pretty little hemispherical *corticate* form." An excellent illustration of the general form of the species accompanies this notice.

In 1878 Carter (xiii.) published a "Note on *Tethea muri-*

cata," in which, after an examination of specimens, he asserts the identity of *T. muricata* with *T. Wallichii*. The particular grounds on which this statement is made are not given, however, nor is any attempt made to reply to Mr. Kent's objections; so that one could hardly regard the matter as settled; I therefore wrote to Mr. S. O. Ridley, of the British Museum, asking him to favour me by examining the type specimen of *T. muricata*, with a view to determining whether it does possess quadriradiate stellates or not. I have to thank him for a valuable letter in reply, and particularly for the following statement, which I venture to quote:—"I have been carefully through with a high power the seven slides which represent the type specimen of *Tethea muricata*, and find nothing which seems to represent the quadriradiate described and drawn by you in your letter and figured by Wright, of which I have now *seen* specimens by examining our slides of '*Dorvillia agariciformis*,' probably representing the type of that species." After Kent's remarks and this explicit statement I consider that we must regard *T. muricata* and *T. Wallichii* as distinct species. In this connexion it is worth noticing that the quadriradiate stellates are the last spicules to appear in the development of *T. Wallichii*; so that very young examples of this species are not distinguishable from *T. muricata*.

In the "Note," Carter further states that *Normania crassa*, Bk., *Hymeniacidon placentula*, Bk., and *Ecionema compressa*, Bk., are no other than various forms of *T. muricata*. In order to enable me to examine the truth of this surprising statement, Mr. Norman placed in my hands the type specimen of *N. crassa*, together with various other specimens, not types, and *a* type specimen of *H. placentula*. I find that all these specimens, including both supposed species, agree in every essential detail with one another, but that they are generically different from *Thenea*, though otherwise nearly allied to it. This was precisely what Mr. Norman predicted. They are without the bifurcated ternate spicules and the grapnels of *Thenea*, and, on the other hand, possess in abundance a small fusiform roughened acerate which is absent from *Thenea*. Moreover the structure of their dermis is completely different; in *Thenea* it is supported by the long rays of the bifurcated ternates, in *Normania* by horizontal fascicles of large fusiform acerates, with an occasional triradiate or quadriradiate spicule. These differences are sufficient to support the generic distinction of *Normania* and *Thenea*; but that they are closely allied is shown by the similarity in the character of their mesodermic tissue, and by the presence in both of the same form of spinispirula; both likewise are Leptochrotæ.

In 1880 Carter (xiv.) again refers to *T. muricata*, retracting some of his previous statements, as when he admits the specific value of the differences between *T. Wallichii* and *T. muricata*; and he still rightly maintains the specific identity of *N. crassa*, *H. placentula*, and *E. compressa*.

Perhaps the most striking contribution made in this communication to nomenclature is the attempt to impose *Tisiphonia* upon it, the claims of *Thenea*, to say nothing of *Wyville-Thomsonia* and *Dorvillia*, being wholly ignored. *Thenea* has precedence of this MS. name by two years; and *Wyville-Thomsonia* and *Dorvillia* were fully defined and illustrated three years before the first figure of *Tisiphonia*, unaccompanied by generic diagnosis, was published in a popular book.

Finally, Oscar Schmidt (xv.), in a work bearing 1880 as the date, also adopts the name *Tisiphonia*, and relies on its rooting fibres as the characteristic feature by which it is distinguishable from *Stelletta*. If it were possible to establish the genus on this character (and I am confident it is not), the claims of *Tisiphonia* to recognition would not be enhanced thereby, since with *Thenea* out of the way there would still remain *Wyville-Thomsonia* and, perhaps with still stronger claims, *Dorvillia* to be disposed of; and till genera are named by one man's caprice this will not prove an easy task. Again, if my contention so far should fail, then I will put in argument the fact that the name *Tisiphonia* has already been twice preoccupied, once by a butterfly (*Tisiphone*), and again by a reptile (*Tisiphone*), and is therefore unavailable.

But, finally, the generic value attributed by Schmidt to anchoring filaments has no existence in the case in point. Amongst Mr. Norman's sponges there is a specimen of *T. Wallichii*, which in no single feature differs from the ordinary type except in one, that, namely, which Schmidt has come to regard as of generic importance. No naturalist would make a different species of it; and yet it has the misfortune to be without anchoring fibres. The distinction of *Thenea* from *Stelletta* is not trifling; it is sharp and obvious. The spicules of the two are, it is true, similar, except that the former is characterized by a spinispirule in place of a stellate; but this difference is just as useful in classification as that between the globate of *Geodia* and the *Stelletta* stellate. The real difference lies, however, as Sir Wyville Thomson perceived in 1869, in the absence of a crust in *Thenea*, which widely separates it from the *Stelletta* series. Other differences almost as great are also known—the clear gelatinous character of the mesoderm, so different from the grey granular mark of *Stelletta*, for one, and the vesicular character of the water-canal system for another.

General Form.—If we imagine a round or oval tureen, with a conical cover overlapping it at the edges, and the foot produced into a number of descending rootlets, we shall have a good idea of the general form of a symmetrically-grown and adult example of *Thenea Wallichii*. The part corresponding to the cover we shall call the upper half, that to the dish the lower half of the sponge; and the space between them overlapped by the edge of the cover we shall call the "equatorial recess." The upper half is usually conical, with a circular oscule at the apex; near the base it curves over into a convex overlapping edge, which covers, as the edge of a thatched roof does the eaves, the rounded annular inflection which we term the equatorial recess. The lower half, which is usually either more or less hemispherical or conical, is produced into a number of descending conical processes, from each of which issues a root as a single fibre, which afterwards frays out into a white woolly-looking tuft by the separation of its component spicules. Variations, greater or less, from the general form are very numerous: the equatorial recess, which in the most symmetrical forms extends all round the sponge, in others frequently fails to do so, being interrupted at intervals, through which the upper and under surfaces pass insensibly into each other; sometimes it is confined to one quarter of the circumference ot the sponge, or even less; and in one specimen, in every other respect precisely like its fellows, it is entirely absent. The roots vary in number: in the youngest specimens they are never more nor less than one; in the largest of Mr. Norman's specimens there are as many as twenty; on the other hand, in one remarkable specimen of average adult size there are no roots at all, nor any signs of their ever having been present. The roots are liable to be given off from abnormal regions: thus, in a specimen from North America, dredged between Anticosti and Gaspé, they arise from one side of the sponge at a place where the equatorial recess would usually be present, but which has been suppressed here and on the adjacent margin, with a compensating over-development on the side opposite; this arrangement would lead to the sponge being so anchored or rooted that the equatorial recess, which is a special poriferous area, would be the uppermost part of the sponge, while the oscule would lie halfway down the side, looking out laterally. A similar modification occurs in another specimen from the same locality, but with a slight difference, which leads to the oscule being situated on one side of the sponge, and the limited equatorial recess on the opposite side, while the roots descend from what appears to be the base, but

which corresponds really to the side of other specimens. These last two specimens may be instances of a local variety, which, however, I shall not dignify by a name, as Schmidt has his *T. fenestrata.* The size of the sponge averages about 1·5 inch in diameter by 1·2 inch in height; the rooting-fibres extend downwards for 0·8 inch usually before fraying out. Mr. Norman's largest specimen measures 3 inches by 2·5 inches in width and breadth, by 1·5 inch in height.

External Surface.—The outer surface of the sponge is felted and thatched by obliquely-projecting, long, slender, acerate, and grapnel-shaped spicules. Round the middle of the upper half, midway between the oscule and the lower edge (tegminal edge we may call it, since it covers or roofs over the equatorial recess), the spicules, lying prostrate almost parallel with the surface, point this way and that, and by their intercrossing form a loosely-felted thicket above the skin—the home of all kinds of animals, Foraminifera (some form of which covers the surface with long strings of sand-grains), Ascidians, worms, and Crustacea. Above this zone the spicules, still projecting obliquely from the skin, point directly towards the apex, so that within a radius of half an inch from it they form a close, regular, but inverted thatch, the free ends of the spicules projecting upwards, and those immediately around the oscule fencing it in with a forest of bristling points. Below the middle zone the spicules proceeding obliquely from the skin point directly downwards towards the tegminal edge, beyond which they project in a fringe of long fine lashes; the thatch is here in the right direction; and the fringe reminds one of the uncut straw hanging over the eaves of a cottage. The lower half of the sponge is covered by obliquely-projecting spicules, showing no regularity in direction, except opposite the tegminal edge; here they point upwards and intercross with the spicules descending from the fringe, forming with them a defensive sieve of great efficiency.

Great variation exists in the distribution and disposition of the spicules as just described; sometimes projecting acerates seem confined to the margin of the oscule and the tegminal edge, or even to the oscular margin alone. Probably in some of these cases the spicules have been lost since the specimen was obtained; in others, on the contrary, they seem never to have been present. Owing to one or other of these causes, *i. e.* abrasion or non-development, or to both, projecting spicules are usually absent over a large part of the skin, the outer surface of which is then clearly exposed to view; it has a greyish tint in spirit-specimens, is often nearly pure white in dried ones. Examining it with a lens, we perceive the

thin skin to lie immediately upon the extended rays of bifurcated ternate spicules, which, regularly overlapping, map out the skin into a number of triangular spaces, most of which are singly perforated by a circular pore 0·004 to 0·01 of an inch in diameter. This arrangement is to be seen on both upper and under halves of the sponge; but in the equatorial recess it is replaced by another. There the skin is separated to a greater extent from the mass of the sponge by the underlying vesicles of the canal-system; it is not supported by the rays of furcate spicules, but fine threads, crossing it transversely, strengthen, support it, and divide it into a number of more or less oval areas, each of which is perforated by a great number of closely-set pores, which reduces it to a fine network (see Kent, xii. pl. lxvi. figs. 3, 4). Of spicules this cribriform floor of the equatorial recess contains chiefly minute spinispirules, and only occasionally quadriradiate stellates.

On cutting the sponge across, one sees a greyish mass enveloped in a thin skin, but without a cortex, traversed by fascicles of spicules and a great number of vesicles; the vesicles lie in rows, longitudinally and radiately disposed.

The Canal-system.—The pores have been already described as distributed generally over the whole surface of the skin, including its conical extensions over the roots of the anchoring fibres. They occupy the triangular spaces in the skin mapped out by the overlapping rays of the furcate spicules below it; usually there is one pore to each space, rarely two. In the equatorial recess the skin is divided into oval areas by fibrous strings, and in these areas is so abundantly perforated by pores as to be converted into a sieve-like net, in just the same manner as described by Schulze in so many Cerospongiæ, and by myself in *Tetilla*, as likewise occurs in many *Esperiæ*, and probably also in a vast number of other sponges. The curious way in which this cribriform poriferous membrane occurs in a recess, while the rest of the sponge is perforated by single pores, reminds one forcibly of similar arrangements in some of the *Esperiæ*. The pores, whether of the recess or the general surface, lead directly into spherical or ellipsoidal chambers or vesicles beneath the skin, the first of a series of vesicular dilatations which constitute the incurrent canal-system (Pl. XVII. fig. 6). For in this sponge the canals are not canals in the ordinary sense of the word, *i. e.* not continuously open more or less tubular channels, but a succession of vesicles, which seldom open into each other except by narrow sphinctrated orifices. Thus, in a linear series of vesicles representing a canal in other sponges, every

vesicle possesses at least two sphinctrated orifices, one putting it in communication with the vesicle behind, and the other with that in front—every vesicle, that is to say, except those beneath the pores; for the pores are not provided with sphincters. The openings into the flagellated chambers are also without sphincters. While two is thus usually the least number of sphincters apparent in a vesicle, a greater number is not uncommon, since, when a lateral series proceeds from a main line, equivalent to the branching of a canal, the first vesicle of the secondary series communicates with that from which it proceeds by a sphinctrate aperture; and thus, as one vesicle of a larger series may bud off, as it were, more than one subsidiary series, it may exhibit four or more sphincters in its walls—two about the communications with vesicles of its own order, and two or more about the communications with vesicles of a lower order. The subsidiary series of vesicles bud off others, and these again others, till the ultimate vesicles are reached which communicate with the flagellated chambers. In this way the size of the vesicles diminishes from 0·015 inch in diameter, which is the average of those in the main series, down to and 0·005 to 0·001, which is that of the ultimate smallest vesicles.

The flagellated chambers (Pl. XVII. fig. 15) are spherical or ellipsoidal sacs communicating by a large circular pore, 0·0032 to 0·006 inch in diameter, with the ultimate incurrent vesicles, and by a wide mouth, from 0·0064 to 0·0096 inch across, with the ultimate excurrent canaliculi. In size they average 0·001 inch in diameter, and thus agree with the similar chambers of the Geodina generally, and of *Tetilla* and such *Esperiæ* as I have examined. This uniformity in size is in striking contrast with the differences which distinguish the chambers of the Chondrosiæ and the Cerospongiæ examined by Schulze, and leads one to suggest that it may result from close genetic relationship.

The excurrent canaliculi lead directly into the nearest vesicle of the excurrent system, about which the flagellated chambers are clustered in a concentric layer (Pl. XVII. fig. 6, *f*). Excepting the canalicular form of its ultimate branches, the excurrent exhibits the same vesicular character as the incurrent system.

The oscule is a more or less circular opening, averaging 0·1 inch in diameter, usually situated in the midst of a gently rising conical eminence; its circular margin is thickened into a lip or annulus of a bluish translucent cartilaginous appearance; and immediately outside this is a surrounding fringe of long acerate spicules. The oscule leads into a wide excurrent

canal or oscular tube, transversely constricted by extensions inwards of its walls, but not so completely as to acquire a vesicular character; the mouths of several tributary series of vesicles immediately open into it; and after proceeding for a very short distance downwards, it completely disappears as a tube, and is continued by several vesicular series, into which it subdivides.

Notwithstanding its wonderful transformation, the canal-system is evidently homologous with that of the more normally constituted sponges; the sphincters which invariably occur at the junction of any two vesicles are almost certainly an excessive over-development of the concentric rugæ which characterize the canals of the Geodina and other sponges, and which are more distinctly developed in the smaller branches of the incurrent canals of *Isops Phlegræi* (see *anteà*, vol. v. fig. 1, p. 403). The first incurrent vesicle immediately beneath the skin is situated in tissue characterized by the absence of flagellated chambers, and is clearly homologous with the ectochone of the Corticatæ. The second vesicle, so far as its outer half, is similarly situated; but its inner half is brought into close communication with flagellated chambers; it thus represents an endochone and a subcortical crypt, while the sphincter by which it opens into the first vesicle exactly corresponds to that which we have termed the chonal sphincter.

It is easier to extract homologies from the modifications of the canal-system than to find a use for them. Had the sponge been a coast-dweller, subject to exposure between tides, one might have regarded the vesicles and sphincters as a provision for retaining a supply of water and thus guarding against desiccation. But, so far from this, it is a characteristic deep-sea form, exposed, as one would think, to but few changes of condition.

The vesicular enlargement of the canals certainly gives them a larger capacity and superficial area, with a corresponding diminution of the quantity of tissue in the sponge: the volume of tissue is here at a minimum, of the canal-system at a maximum; thus the advantage is on the side of increased food-supply, while the quantity of tissue to be fed is diminished. Furthermore, not only does the vesicular arrangement permit of a larger quantity of water being present in the sponge at any given moment, but it facilitates a rapid passage of water through it; and, taking this fact along with the abundance of large pores all over the sponge, it would appear as though the most characteristic features of the canal-system were in special adaptation to a free and rapid water-streaming. We might then expect to find the body of the

sponge exceedingly well nourished and abounding in protoplasmic structures; and yet, when we come to study its histology, we shall find that it is distinguished, in marked contrast with the Corticatæ, by the small proportion of its protoplasmic contents, the great mass of the sponge consisting of a gelatinous matrix which, whatever its composition may be, is certainly something very different from protoplasm. The rapidity of the water-streaming is therefore probably connected with the poverty in food-particles of the surrounding water, a great deal of water having to pass through the sponge in order to afford it sufficient nourishment.

The sphincters probably act as regulators to the water-streaming, checking it when the water is more than usually burdened with suspended particles, allowing it freer passage when food is scarcer. They might also govern its distribution, closing the passage in some directions, opening it in others, though, in the presumed absence of a combining apparatus such as a nervous system would furnish, this seems unlikely.

In connexion with the "wide-openness" of the canal-system, the small size of the oscule is worthy of note. It seems to point to a rapid escape of the outflowing water, and its consequent ejection to a considerable distance from the inhalant surface. The relative size of the poral and oscular areas in different sponges has never yet been made the subject of investigation, although it differs greatly in different species, and must stand in close connexion with the physiology of the water-streaming system. As a beginning, I have attempted to determine, in the case of this sponge, (i.) the ratio of the poral to the superficial area, and (ii.) the ratio of its total poral area to its total oscular area. In order to make the first determination, a specimen was taken from spirits and allowed to drain till the edges of the open pores just became visible; a part of the surface with its pores was then accurately sketched with the aid of an oblique reflector and under a magnification of thirty diameters. We shall not need to trouble about the absolute size of the pores, as we are only about to determine a ratio. A given area of the drawing was next taken, and the area of the pores in it calculated. I give the results obtained in two instances. In the first—

(i.) The area of the sponge-surface taken from the sketch was 6 square inches.

(ii.) It contained sixteen pores, of which two had a diameter of 0·3 inch, two of 0·25, two of 0·22, eight of 0·2, and two of 0·1.

The total area of these is 0·58216 square inch; and

$$6 : 0{\cdot}58216 = 1 : 0{\cdot}097,$$

i. e. 1 square inch of the sponge-surface contains 0·097 square inch of pore-area.

In the second—

(i.) The area of the sponge-surface taken (in the sketch) was 1·5 square inch.

(ii.) It contained twelve pores, two of 0·2, two of 0·15, and eight of 0·1 inch in diameter.

The total area of these is 0·14283 square inch; and

$$1{\cdot}5 : 0{\cdot}14283 = 1 : 0{\cdot}095,$$

a close correspondence for two quite independent determinations, and remarkable considering the difference in the average size of the pores measured in the two cases; it would appear that the smaller pores made up in number for what they lacked in magnitude. Taking the average we obtain 0·096 : 1 as the ratio of the poral to the general area; and the number 0·096 may be called the pore-index of the sponge.

We have next to ascertain the relative size of the total poral to the total oscular area. The specimen on which the preceding observations were made measures 4·084 inches in circumference and 0·8 inch in height; it may be regarded as formed by two equal segments of a sphere 0·9 inch in diameter, each 0·4 inch high, and thus has a superficial area of 2·26 square inches. Multiplying 2·26 by 0·096, the poral index, we have 0·172 square inch as the total poral area; so, if all the pores were to coalesce, they would form a single aperture under one fifth of a square inch in area. This, however, is an underestimate, since no account has been taken of the larger number of pores in the equatorial recess.

The oscule is 0·1 inch in diameter, or 0·007854 square inch in area; and the oscular (O) is consequently to the poral (P) area as

$$0{\cdot}007854 : 0{\cdot}172 = 1 : 22.$$

$$\therefore \frac{P}{O} = 22.$$

This number may be conveniently styled the poral-oscular index. Its determination is here probably a little too low; but it suffices to show that, with an almost imperceptible influx of water into the pores of the sponge, there may be a very lively discharge from the oscule. A determination of the value of $\frac{P}{O}$ was made in a second specimen, unfortunately a

dried one, so that the results are not trustworthy. The calculation is as follows:—Total area 6·16 square inches, total poral area consequently 0·59136 square inch; area of single oscule 0·0416 square inch; $\frac{P}{O}=\frac{0 \cdot 59136}{0 \cdot 0416}=14 \cdot 2$. The smallness of this number is probably due to the large size of the oscule, consequent on its enlargement by drying.

To ascertain, further, whether any definite relation exists between the general and oscular areas, and consequently between the poral and oscular areas, the largest of Mr. Norman's specimens was examined. In form it approximates to a hemisphere with a radius of 1·4; so that its total area may be taken as 18·475 square inches. It bears six oscules, giving one to every 3·08 square inches of total area.

In the first examined specimen (see *anteà*) we had 2·26 square inches to one small oscule, in the second 6·16 square inches to one large oscule; taking an average from these we have 4·21 square inches to each oscule. Though this is sufficiently greater than the value found from the third specimen to prove that the relation between the general and oscular area is by no means precise, it yet indicates some kind of broad connexion which it may be worth while to further investigate.

The Skeleton.—The large spicules of the skeleton are stout fusiform, and slender filiform, acerates, simple and bifurcated forks, and variously-shaped grapnels. The small spicules are spinispirulæ of two kinds:—(i.) The stout fusiform sharp-pointed acerates are the staple body-spicules; they measure frequently 0·2 inch in length by 0·034 in breadth, and appear sometimes to attain to as much as 0·5 inch in length. (ii.) The long slender acerates, which project beyond the general surface of the sponge, are seldom seen entire, so that it remains doubtful in many cases whether they are truly acerates or only the shafts of grapnel-spicules; they may reach 0·7 to 0·8 inch in length. (iii.) The commonest forks (Kent (vii.), figs. 6, 7) are bifurcated ternates with exceedingly long rays, the primary rays usually measuring about 0·01 inch, and the secondary 0·047 inch in length; the shaft varies greatly, but is often 0·19 to 0·2 inch long; at a short distance below the head it often undergoes a rapid diminution in thickness, becoming almost filiform towards its proximal end, something like a tap-root. (iv.) The forks (*vide* Bwk. (x.), fig. 3) with undivided simple rays are frequent; they are also of very various sizes, 0·27 inch is a not unusual length for the shaft, and 0·034 inch for the rays.

It is not unusual for both kinds of forks to have the rays

rounded off at the ends, so that, instead of being long, slender, and pointed, they become short, thick, and stumpy. The proximal end of the shaft is sometimes rounded off in the same way.

(v.) The grapnels (Pl. XVII. fig. 4) are distinguished by their long, sharp, usually straight rays, but there is great variation among them in this and other respects; in one form (fig. 4) the head of the shaft is scarcely at all thickened, and the long rays start with a wide outward sweep from it (at an angle of 55° to 60°) and then somewhat abruptly turn backwards and run more nearly parallel with it, frequently at an angle of 18° to 20°; in another form the shaft thickens towards the head, which is thick and long, and the rays form only short, stout, widely-diverging prongs (Pl. XVII. fig. 14); but there is every intermediate form between these two, and many minor variations surrounding them; in the expansion or not of the shaft below the head, in the size and form of the head, in the length of the rays and the angle they form with the shaft, there is great variety; by far the commonest form, however, is that shown at fig. 4, or some close approach to it. Those grapnels which lie entirely within the body are often 0·1 inch long in the shaft, with rays 0·0082 inch long; those which extend beyond it have not yet been observed entire, but have been measured up to 0·34 inch in length, and probably in the entire state they are sometimes not much shorter than 1 inch.

The development of the grapnels will be described in treating of the young forms of the sponge.

(vi.) A not uncommon variety of large spicule remains to be noticed (Pl. XVII. fig. 3); it resembles the shaft of a ternate spicule, but instead of dividing it thickens club-like at the distal end; in some cases (fig. 17) a protuberance representing a rudimentary ray occurs on one side. These spicules call to mind the club-shaped forms of *Rhaphidotheca Marshall-Halli*, and are either young forms of ternates, or ternates in a state of arrested development, or abnormal forms of the fusiform acerate spicule.

(vii.) The smallest of the minute spicules are the spinispirulæ (Pl. XVII. fig. 24); these consist of a straight or curved shaft, from which spines arise along a spiral course and project radially; the spines are usually sharp-pointed and smooth, but frequently also very finely roughened all over, often with quite abruptly truncated ends. The shaft sometimes becomes very short; and then the spinispirula is scarcely distinguishable from a minute stellate.

(viii.) The larger minute spicule appears to be a spinispirula reduced to a very simple form (*v.* Kent, vii. figs. 16, 17, 18).

It most commonly consists of a very short straight shaft with two long spines radiating from each end, the plane containing the spines at one end being frequently turned at right angles to that containing those at the other, a disposition which suggests a spiral arrangement, not otherwise discoverable in the shaft. Almost as frequently, however, all four spines lie in one and the same plane (*v.* Kent, vii. fig. 18). The number of rays varies greatly: sometimes only two appear, giving us a bent acerate form; often only three, the triradiate so formed closely resembling the characteristic spicule of the Calcispongiæ; four is the commonest number; but additional rays are not uncommonly present, up to and possibly exceeding eight; in instances where the number of rays exceeds five the spiral tendency is more markedly displayed. The shaft sometimes shortens and disappears; and then the four-rayed form resembles the quadriradiate of *Dercitus* (*v.* Kent, vii. fig. 16). The fourth ray often appears as a sprout from one of the rays of a triradiate. The spines are usually sharply pointed, but often become rounded at the ends (fig. 13); they are smooth and only very rarely roughened. In size these spicules vary enormously: the rays of the larger forms are frequently 0·0034 inch long, but they may reach 0·005 or more; in the smaller forms they are often no more than 0·00091 inch long. By multiplying the length of the rays by 2 we get a close approximation to the length of the whole spicule.

The minute spicules are scattered without apparent arrangement through the sponge; the large spicules, on the contrary, lie in fascicles or short fibres, which radiate from the centre to the surface, the rays of the forks spreading out beneath the skin, and the heads of the grapnels lying close beneath them, in the angle between the rays and their shafts. The forks appear never to extend outside the surface of the sponge; but the acerates and the grapnels project a considerable distance beyond it. The proximal ends of these projecting spicules appear about each fibre a little below the skin (Pl. XVII. fig. 6); and the spicules, diverging from each other, pass out in a conical pencil, having its apex pointing inwards. Towards the base one finds in addition numerous spicules converging from the middle of the sponge towards conical papillæ, from which they emerge as single fibres; here the base of the cone is inwards; the fibres afterwards open out to form the terminal tufts of diverging spicules, the greater part of which appear to be grapnels.

The Ectoderm.—The epidermis (Pl. XVII. fig. 32) is a thin membrane everywhere investing the sponge, and bearing

immediately on its under surface very definite minute round nucleolated nuclei 0·000125 inch in diameter, each of which is situated in the midst of a cluster of fine granules; it is clearly a layer of pavement-cells from which the cell-outlines have disappeared. Very fine fibrils are usually apparent wandering over its lower surface; they are probably the tenuous ends of branching processes extended from the corpuscles of the underlying connective tissue. The ectoderm is continued inwards as an epithelial lining (Pl. XVII. fig. 47) to the incurrent canals or vesicular system, from no part of which is it absent. In describing the ectoderm of *Tetilla* we stated that the characteristic minute spicules of the sponge (hamates) appear to contribute to its composition; similar components appear also in the ectoderm of *Thenea.* The spinispirules which in this sponge represent the hamates of *Tetilla* are associated, wherever they occur, with a small round nucleus, which lies close to their shaft between two of its spines; when the shaft is curved the nucleus lies in its concavity (Pl. XVII. fig. 24). The nucleus of the spinispirules is undistinguishable in character from that of the ectodermic cells; and in many cases one can see in the epithelium lining a vesicle a nucleus otherwise precisely similar to its fellows, but here embraced by the concave shaft of a spinispirule, and so closely as to show that it belongs to the spicule, which on its part lies so near to the epithelium that its minute spines project through it (Pl. XVII. fig. 47). The nucleus is clearly a part of the epithelium; but likewise it belongs to the spicule; and thus it would appear that the spicule is a genuine component of the epithelium. But spinispirules in association with epithelial and epidermic nuclei are far from uncommon, indeed remarkably frequent; so that we are led to conceive of these membranes as to a considerable extent composed of spicule-bearing cells. Further, as in *Tetilla*, we are brought to the alternative of regarding the ectoderm as a skeletogenous tissue, or of admitting that mesodermic cells may find their way into it and contribute to its formation.

Endoderm.—This lines the excurrent system of vesicles as an epithelium which does not differ from the ectoderm except when it forms the walls of the flagellated chambers. The flagellated cells, in their present state, are rounded or oval bodies 0·000125 inch in diameter, with a well-marked round nucleus containing a nucleolus. They are seated on the walls of the chamber, about 0·00011 inch remote from each other on the average, and number about forty to a chamber. Sometimes one is to be observed markedly larger than the others, 0·00028 inch in diameter; and sometimes a little heap of four

small ones is to be seen, as if resulting from the fission of one of the unusually large forms (Pl. XVII. fig. 21).

Mesoderm.—This consists of a gelatinous connective tissue, of which the matrix is a quite colourless transparent jelly, highly unalterable by acids and alkalies, and remarkably poor in granules, those present being exceedingly minute; its corpuscles (Pl. XVII. figs. 25, 29, 30) consist of a variable quantity of granular propoplasm, often vacuolated, and provided with an oval or round nucleus 0·00013 to 0·00017 inch in diameter, within which is a minute nucleolus. The outer protoplasm extends into long branching processes, which terminate in threads, scarcely traceable near their ends for fineness. Sometimes the threads diminish regularly up to their ends; sometimes after diminishing they thicken out up to a point of bifurcation (fig. 30); frequently the angle of the bifurcation is filled up by an accumulation of protoplasm; sometimes, finally, a short process from the corpuscle thickens into a lump of sarcode at the end, from which several short hair-like processes radiate outwards (Pl. XVII. fig. 30). Sometimes the fine ends of the threads appear to terminate freely; more often they unite with those from neighbouring corpuscles. A large proportion of them are elongated in one direction and joined end to end to form long granular nucleated threads (Pl. XVII. fig. 25); the lateral branches proceeding from the protoplasm about the nuclei of the corpuscles unite with similar threads or enter other corpuscles. Sometimes the matrix about the fibre becomes in places finely fibrillated parallel with it (fig. 25, *f*). The ends of the fibres or of the branches from them appear to be ultimately brought into close connexion with the ectodermic and endodermic layers; for on the inner faces of these layers fine filamentous processes are often seen wandering, and the branching filaments of connective-tissue corpuscles can frequently be traced right up to them; in several cases also, I believe, I have seen a connexion between the individual cells of a flagellated chamber and the branching processes of a corpuscle (fig. 15). It is, indeed, difficult while studying this reticulum of connective-tissue corpuscles to resist the idea that we are here dealing with something that plays the part of a nervous system. And just as the nervous tracts usually follow and are protected by the skeletal structures, so here a large number of the corpuscular fibres are seen running parallel close by the side of the chief spicules of the body. On the other hand, the modifications which some of the corpuscles undergo seem inconsistent with special nervous properties.

In an irregularly defined layer a little below the skin, at

about the level of the first and second vesicles of the incurrent canal system, the connective-tissue corpuscles have undergone a remarkable internal change (Pl. XVII. fig. 18). Within the granular protoplasm a smooth shining globule makes its appearance; it is colourless, transparent, homogeneous, and highly refringent. In some corpuscles only one such body is present; in others several, lying in close contact with flattened apposed faces. The number in different groups does not follow any regular series, such as 1, 2, 4, 8, &c., but any number may occur from 1 to 8, and perhaps more: nor are the granules of a group all of the same size; there may be one large and several smaller ones of various degrees of minuteness. Sometimes they lie in immediate contact with the protoplasm, more often separated from it, lying in a vacuolated space. We are able fortunately to determine the stage in which they earliest appear, by finding them in evidently very young corpuscles, distinguished by the large quantity of their finely granular protoplasm, which takes a specially deep stain with reagents. From this starting-point we can readily trace their history as they are followed deeper into the interior of the sponge. In corpuscles a stage older than the preceding we find the protoplasm becoming less granular, staining much less deeply with carmine, and diminishing likewise in quantity, so that it forms a mere spherical or oval shell around the granules, but still retaining its outward radiating processes (Pl. XVII. fig. 19); these, however, in the next stage also disappear, and the corpuscle becomes simply a mere oval or spherical sac, filled with the products of its metamorphosis or secretion, amidst which the nucleus lies concealed (Pl. XVII. figs. 26, 45, 46). The shining granules next begin to diminish in number and size, and at length finally disappear, leaving as an effete residuum the investing sacs, which, lined by a small quantity of protoplasm produced sometimes into branched processes and showing the now reexposed nucleus, contribute largely to the histological elements of the gelatinous tissue (Pl. XVII. figs. 31, 44).

The manner in which the fat-like granules make their appearance and their subsequent history seem to point to their being food-reserves of some kind; but of what kind in particular, one cannot safely even conjecture. They stain deeply with carmine, turn brown, and not blue, with iodine (i.), do not dissolve in ether or chloroform (ii.), nor in boiling water (iii.), nor in strong sulphuric acid (iv.); strong acids, indeed, like nitric and sulphuric, seem to have no action upon them in the cold, even after prolonged treatment; iodine does not

stain them blue after treatment with sulphuric acid (v.): a 5-per-cent. solution of potash hydrate dissolves them; but the resulting solution does not reduce copper from Fehling's solution (vi.). By (i.) they are proved not to be any common form of starch, by (ii.) not fat, by (iii.) not inulin, by (iv.) not tunicin, by (v.) not cellulose, and by (vi.) not sugar. What they are, not one test indicates; and one is led to think they may be some kind of albuminoid.

Another constituent of the mesoderm is furnished by the muscle-fibres, which occur chiefly as forming the sphincters about the openings of the vesicles (Pl. XVII. fig. 47). They are fusiform bodies prolonged at each end into long slender filaments, 0·0002 inch across where broadest, and 0·014 inch in length, composed of granular protoplasm, which stains deeply with carmine, and is thus rendered very distinct amidst the unstained colourless jelly of the matrix, and containing in the middle a round, or more usually oval, nucleus 0·000148 inch broad, with fluid contents and a minute round nucleolus. Occasionally the body of the fibre exhibits very distinct longitudinal striation. The muscle-fibres lie side by side concentrically arranged, to form the sphincters; the ends of some of those towards the outside of the sphincters escape from them tangentially, and wander into the surrounding matrix, where they appear to become connected with the fine terminations of the connective-tissue corpuscles—a union still further suggestive for the latter bodies of a nervous function.

Fibres similar, but differing in slight details from those of the sphincter, run radiately from its outer margin into the surrounding tissue; these are connective-tissue corpuscles.

Large amœbiform cells with pseudopodium-like processes, gigantic oval nuclei, and included spherical nucleoli are to be seen here and there in the mesoderm (Pl. XVII. fig. 48). They never occur in definite lacunæ, like the similar cells of *Tetilla*. It is probable that they become converted into sperm-balls, like those to be presently mentioned.

Spicule-cells have been already mentioned in connexion with the spinispirules; these little spicules are frequently found with an accumulation of protoplasm about their shafts, which extends as a granular fibre over their spines, and contains a small round nucleus with a nucleolus. The large quadriradiate spinispirules occasionally, but not often, present cases of indubitably associated nuclei. The large body-spicules frequently bear on one side of the shaft a large cell, something like the amœbiform cells noticed above, the granular protoplasm of which extends into a thin film, traceable for greater or less distances along the spicule, just as described in similar

cases in *Tetilla* (Ann. & Mag. Nat. Hist. ser. 5, vol. ix. pl. vii. fig. 18).

Sperm-balls (Pl. XVII. fig. 28) are the last constituents of the mesoderm to which we need allude; they are rounded or oval clusters measuring about 0·0071 inch along the minor, and 0·01 inch along the major axis, consisting of a vast number of closely packed spherical bodies of various sizes, from 0·00025 to 0·000057 inch in diameter. These stain deeply with carmine; they present no trace of flagella, and are probably spermatozoa in an unripe state. Immediately surrounding each sperm-ball the gelatinous matrix is very finely fibrillated, and outside this thin fibrillar layer abounds in young abundantly and frequently coarsely granular protoplasmic cells (Pl. XVII. fig. 1), which appear to be connective-tissue corpuscles, with short branches and in a very active state of growth. The large amœbiform cells are also sometimes found close to the sperm-ball. Besides these, abundant fusiform connective-tissue corpuscles radiate from the surrounding tissue towards the sperm-cluster, and penetrate the fibrillar layer which immediately surrounds it. This layer, when seen from the inside by the removal of the sperm-granules, presents the appearance of very fine curved striæ, which wander about in all directions, but exhibit a more or less concentric direction about the ends of the fusiform corpuscles which they surround (Pl. XVII. fig. 16).

Finding such a specialization of the mesoderm about each sperm-ball, one almost expects to find them also characterizing some special region of the body; but this is not the case; they occur as near the top as the bottom of the sponge; and all one can say is that they do not approach nearer the surface than the third vesicle of the incurrent system.

Development.—On the early stages of development I can contribute no information; but Mr. Norman's specimens have furnished me with six very young forms, which differ in several particulars from the adult sponge. All six agree in having a prolately ellipsoidal body provided with a single anchoring fibre; and in none is there any trace of an equatorial recess. This is also absent in Prof. Wright's specimen; but in a little example 0·5 inch broad by 0·4 inch high, with five rootlets, it is perfectly developed, as also are all the other characters of the adult sponge. The length of the body in the smallest specimen (Pl. XVII. fig. 7) is 0·02 inch, in the largest 0·06 inch. The anchoring-fibre is continued through the centre of the body as an axis; and a tuft of spicules projecting from the oscular end seems to be its upward termination. In the larger specimens the tufts of spicules radiating from the oscular

region outwards are more numerous than in the smaller; and in the largest a branch from the axis downwards seems to be a second rootlet. The spinispirules do not differ from those of the adult; but the quadriradiate spirules are absent from the two youngest forms.

The slender spicules of the anchoring-fibres, over which the ectoderm extends, are mostly rounded at the distal end (Pl. XVII. fig. 39), like many of the spicules of *R. schœnus*, or the forms which so frequently occur as varieties amongst the pin-shaped acuates. These represent the first stage of the grapnel-spicules, which thus differ from the similar spicules in *Tetilla* by the absence of an initiatory inflation. In the next stage (Pl. XVII. figs. 33–38) these spicules exhibit near the distal end a number of little tubercular excrescences, similar to those which occur as abnormal thickenings on many of the spicules both of the Monaxonidæ and the Tetractinellidæ. In many cases these tubercles take the form of small teeth, often recurved, and varying in number from one to six. They are seldom situated at the extreme end of the spicule, usually a little distance from it. In the larger specimens we find a considerable advance in growth and development; the spicules show a marked increase in size; and though some of these larger forms still present a merely rounded end, others possess in addition from one to three short conical teeth budded off at some little distance before the end (Pl. XVII. figs. 40 to 42). There is still not the slightest trace of any terminal inflation, such as occurs in *Tetilla*-grapnels. The rays arise merely as spines, precisely similar at this stage to the more numerous spines which cover the distal end of the quadriradiate spicules of *Tricentrium muricatum*. We may indeed, on the basis of these observations, regard the rays of these grapnels as highly developed spines, which, at their inception indefinite in number, become subsequently limited to three. The club-shaped spicules, previously mentioned as the probable parents of the forks, have also been observed in these young forms; but no spines have yet been found proceeding from them. The bifurcated forks, however, are in these early stages very small, their rays being 0·006 inch long, while those of the adult are 0·05 inch, or eight times as long.

Classification.—*Thenea* is evidently a true tetractinellid sponge; but it differs from those hitherto described in this Report by the complete absence of a cortex, and thus is a typical example of our Leptochrota; this character has been noticed long ago by Sir Wyville Thomson, who, in his paper on *Holtenia*, recognized its classificatory value, and founded his suborder Leptophlœa upon it. This suborder is nearly the same as my

Leptochrota—the similarity in names, however, being only what we call accidental, arising really from our both having the same idea to express in a single word. Thomson's sub-order, however, was intended to include monaxonid as well as tetractinellid sponges, and thus, ignoring a distinction which all spongologists are now agreed to regard as fundamental, cannot be maintained. This is not the case with Leptochrota, which is a division of the Tetractinellidæ, not of the heterogeneous group Radiantia; Leptochrota, therefore, escapes anticipation, though by a very narrow chance.

As secondary characters distinguishing *Thenea* we may cite the vesicular character of the canal-system, the superabundance of clear gelatinous matrix in the mesoderm, and the substitution of spinipirules for stellates. As agreements of doubtful value with other sponges, we have the similarity in size of its flagellated chambers with those of the Corticata and such *Esperiæ* as I have examined, and the resemblance of its club-shaped spicules to those of the Esperiad *R. Marshall-Halli*. This latter resemblance I regard as possibly due to homoplasy; but in any case it is eminently suggestive of the manner in which the tetractinellid spicules have been evolved.

Distribution.—Kors Fiord, Norway. Station 13, 200 to 300 fathoms. The following occurrences are also recorded:—Atlantic, 58° 23′ N., 48° 50′ W.; 1913 fms. (*Wright*). *Loc.?* 500 fms. (*Kent*); Florida, 178 fms. (*O. S.*); between Anticosti and Gaspé, 220 fms. (*Whiteaves*). Grey ooze generally (*W. Th.*).

Broadly speaking, therefore, it is known on both sides of the Atlantic, from Norway to Florida, and ranging from 100 to 2000 fathoms in depth. Probably its area will be found to be much more extended than this: there is, indeed, a suggestion of its occurring in the Pacific; for Mr. Norman has placed in my hands a specimen which seems specifically identical with *T. Wallichii*, and which came, according to the assertion of the dealer who sold it, from Cebu.

EXPLANATION OF PLATE XVII.

Thenea Wallichii, P. Wright.

Fig. 1. One of the coarsely granular cells in the connective tissue surrounding a sperm-ball (×500).

Fig. 2. Median longitudinal section through the sponge: *o*, the oscule; *t*, tegminal edge; *e*, equatorial recess (nat. size).

Fig. 3. A variety of acerate spicule, with swollen distal end (probably a precursor of the tetractinellid form) (× 30).

Fig. 4. A grapnel-spicule from the body of the sponge (× 45).
Fig. 5. A fusiform fibre from the outer margin of a sphincter (× 435).
Fig. 6. Section from the skin, a short distance inwards. *a*, first incurrent vesicle (=ectochone); *b*, second incurrent vesicle (=endochone and subcortical crypt); *s*, a sphincter; *c*, excurrent vesicle; *d*, *d*, layer characterized by food-reserve cells; *e*, inner ends of a tuft of spicules projecting from the skin; *f*, flagellated chambers. × 22·5.
Figs. 7–12. Outlines of six young forms of *Thenea* (× about 3).
Fig. 13. Pauciradiate stellate or spinispirule, with the spines rounded at the ends (× 315).
Fig. 14. Head of a form of grapnel-spicule common in the anchoring tails (× 166).
Fig. 15. Flagellated chamber, with a large cell seated, like a flagellated cell, on the wall, but connected by a short process with a fusiform connective-tissue corpuscle: *p*, incurrent pore (× 250).
Fig. 16. The inner face of the wall of a cavity, containing a sperm-ball, showing its fibrillated structure and the ends of the connective-tissue corpuscles which penetrate it (× 250).
Fig. 17. Club-shaped distal end of abnormal acerate, showing a rudimentary spine at one side (× 166).
Fig. 18. A young granular cell, containing a large shining grain of undetermined nature—food-reserve cell (× 500). The series of changes which this kind of cell appears to undergo is represented by figs. 19, 26, 43, 45, 46, 44, 31, in the order here given.
Fig. 19. Food-reserve cell (× 500).
Fig. 20. A young granular spherical cell common in the gelatinous connective tissue, and sometimes apparently forming one of the cells of a flagellated chamber (× 500).
Fig. 21. Part of a flagellated chamber seen in optical section, with a group of three young cells within a common cell-wall (× 500).
Fig. 22. Some of the spherical granular bodies which compose a sperm-ball (× 500).
Fig. 23. A flagellated chamber with a connective-tissue corpuscle ending in fine processes over its wall (× 500).
Fig. 24. Spinispirule with its nucleus (× 500).
Fig. 25. A thread of united connective-tissue corpuscles; at *f*, the gelatinous matrix immediately surrounding a corpuscle shows a fine longitudinal fibrillation (× 333).
Fig. 26. Food-reserve cell containing four granules (× 500).
Fig. 27. Fibrillæ in layer surrounding a sperm-ball, having the appearance of tails radiating from the sperm-granules, indicated by the small circles (× 500).
Fig. 28. A sperm-ball with its surrounding layer of modified gelatinous connective tissue (× 20).
Fig. 29. A branching connective-tissue corpuscle, having one of its fibres continuous with a fusiform cell resembling a muscle-fibre: *v*, vacuole (× 500).
Fig. 30. A connective-tissue corpuscle (× 500).
Fig. 31. A cell from the gelatinous connective tissue, consisting of a thin wall enclosing a large vacuole-like space and a round nucleus (probably an exhausted food-reserve cell) (× 500).
Fig. 32. A small portion of the epidermis seen *en face* (× 500).
Figs. 33–38. Young forms of grapnel-spicules from the roots of the young specimens indicated by figs. 7 and 8 (× 315).
Figs. 39–42. Also young forms of grapnels, from the specimens of figs. 10–12 (× 315).

Fig. 43. Small spherical cell with protoplasmic contents, vacuole, and food-grain (× 500).
Fig. 44. Connective-tissue corpuscle with large vacuole (probably an exhausted food-reserve cell) (× 500).
Figs. 45, 46. Cells with large vacuoles and food-grains (× 500).
Fig. 47. A vesicle of the canal-system, showing the nuclei of its epithelial cells and associated spinispirules: *b b*, edge of the vesicle; *s*, sphincter; *c*, surrounding connective tissue. × 250.
Fig. 48. Large amœbiform cell of the connective tissue (× 333).

L.—*Description of a new Species of* Crastia, *a Lepidopterous Genus belonging to the Family* Euplœinæ. By F. Moore.

Crastia Distantii.

Upperside dark cupreous brown, glossed with olive-green: fore wing with a series of eight or nine white submarginal spots, and a marginal row of small spots, similarly disposed and of the same shape as those in the Malayan *Euplœa Bremeri*, Feld., but somewhat larger; two small spots also on the disk below the upper and middle median veins in some specimens; a short slender sericeous streak between the lower median and submedian in the male: hind wing with two rows of prominent white spots.

Underside greenish olive-brown: fore wing with marginal markings as above; two small spots also on the costa, another spot at the end of the cell, and three on the disk: hind wing with prominent marginal spots; a spot at the end of the cell, and five spots beyond. Expanse $2\frac{6}{8}$ to $3\frac{1}{8}$ inches.

Hab. Sumatra. In coll. F. Moore.

LI.—*Researches on the Nervous System of the Larvæ of Dipterous Insects.* By Prof. Ed. Brandt.

Having received from M. Behling a number of Dipterous larvæ belonging to families which had not been previously examined as to their nervous system, I took the opportunity to dissect them, and with the following results.

I have examined the following:—

Leptidæ: *Leptis*, sp.
Bibionidæ: *Bibio Marci*, L.
—— *Pomonæ*, Fabr.
—— *ferruginatus*, L.
—— *varipes*, Meig.
—— *hortulanus*, L.
—— *laniger*, Meig.

Bibio Johannis, L.
—— *clavipes*, Meig.
—— *albipennis*, Meig.

XYLOPHAGIDÆ: *Xylophagus ater*, Fabr.

THEREVIDÆ: *Thereva nobilitata*, Fabr.

DOLICHOPODIDÆ: *Dolichopus popularis*, Wied.
—— *vulgaris*, Meig.

The larvæ of Leptidæ have thirteen ganglia—two cephalic (g. supra- et infraœsophageum), three thoracic, and eight abdominal. All the ganglia are united by double connectives, as in the imago *—a very peculiar formation, only found in this family. In the other families of Dipterous insects these connectives are simple.

The larvæ of Bibionidæ, Therevidæ, and Xylophagidæ have, like the Asilidæ (*Laphria atra* according to L. Dufour, and *Laphria gilva* and *Asilus geniculatus* according to my researches), thirteen ganglia, occupying the whole length of the body, and united by simple connectives. The nervous system of the larvæ of those families has two cephalic, three thoracic, and eight abdominal ganglia. The first and the second thoracic ganglia of the larva are near to each other; but the third thoracic ganglion is further apart from the second than the latter from the first. The first two thoracic ganglia are afterwards fused, and form the first of the two thoracic ganglia of the adult insect; and the third thoracic ganglion of the larva is fused with the first abdominal ganglion, and forms the second thoracic ganglion of the adult insect.

The larvæ of Dolichopodidæ have thirteen ganglia, so that there are two cephalic, three thoracic, and eight abdominal ganglia. All the ganglia are united by simple connectives, and occupy the whole length of the body. From my researches on the nervous system of the Dolichopodidæ (*l. c.*) it is known that the imago has two cephalic ganglia and two ganglia in the thorax. The first thoracic ganglion is formed by the fusion of the first two thoracic ganglia of the larva; and the second thoracic ganglion of the adult insect is formed by the coalescence of the third thoracic ganglion of the larva with all the abdominal ganglia.

I have also examined some larvæ of genera and species the nervous system of which was not known till now, belonging to the following families:—

* Ed. Brandt, "Vergl. anatom. Unters. üb. d. Nervens. d. Dipteren," Horæ Societ. Entom. Ross. xvi. 1879.

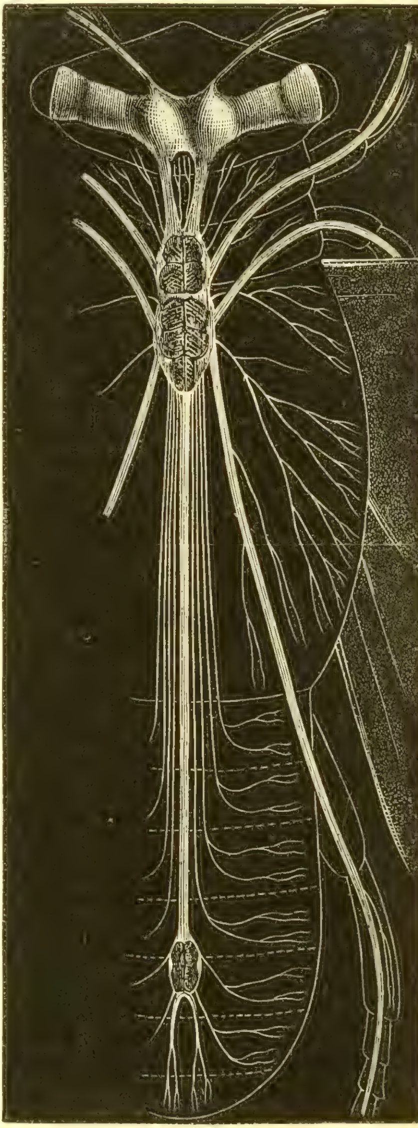
FUNGICOLÆ :	*Sciara nigrescens*, Winnerts.
	—— *rufiventris*, Macq.
	—— *gregaria*, Behling.
	—— *Behlingii*, Winn.
	Rhyphus fenestralis, Scop.
	—— *punctatus*, Fabr.
LIMNOBIIDÆ :	*Tipula lutescens*, Fabr.
	Epiphragma picta.
	Pedicia rivosa.
TABANIDÆ :	*Tabanus bromius.*

The larvæ of Fungicolæ have thirteen or twelve ganglia. *Sciara* has thirteen ganglia (two cephalic, three thoracic, and eight abdominal). *Rhyphus* has twelve ganglia, two cephalic, three thoracic, and seven abdominal; and the last abdominal ganglion results from a fusion of two ganglia.

The larvæ of the Limnobiidæ have thirteen ganglia, two cephalic, three thoracic, and eight abdominal. The thoracic ganglia are very close together; the ganglion infraœsophageum is very near to the first ganglion thoracicum; and the first abdominal ganglion is very near to the third thoracic ganglion; so that these five ganglia seem to form a single thoracic nervous mass. All the ganglia are united by simple nervous cords, and are arranged along the whole length of the body.

The larvæ of Tabanidæ have only seven ganglia; and there are one cephalic ganglion (ganglion supraœsophageum and no ganglion infraœsophageum), one thoracic ganglion, and five abdominal ganglia, occupying the whole length of the abdomen. The first, second, and third abdominal ganglia are not near to one another; but the last two are very close together. Some time ago J. Künckel described the nervous system of the Tabanid larvæ, and stated that they have only two ganglia, one cephalic and one thoracic, and that only in the pupa state is there disjunction of the ganglia. I do not know if it is owing to a difference of age or of the species; but the larvæ of *Tabanus bromius* (Künckel does not say what species he examined) have all the abdominal ganglia, in the same number and similarly arranged, as in the adult insect; only the ganglion infraœsophageum is of late formation (in the pupa), by a disjunction from the anterior part of the single thoracic ganglion of the larva (as in Muscidæ). Thus the nervous system of the larvæ of the Tabanidæ constitutes an intermediate form between the nervous system of the larvæ of the Muscidæ and the nervous system of the larvæ of the Nemocera and some other families of Dipterous insects.

LII.—*On the Nervous System of the Strepsiptera.* By Prof. EDWARD BRANDT *.



THE nervous system of the Strepsiptera has not been subjected to any special researches. C. Th. von Siebold† only states that these insects (*Xenos vesparum*) have one thoracic ganglion; but he does not say any thing about the number of cephalic and abdominal ganglia.

My researches have been limited to four females and one male of *Stylops melittæ*, and one female of *Xenos vesparum*, preserved in spirit.

The results of my researches are the following:—

1. The cephalic division of the nervous system consists of the *ganglion supraœsophageum* only, the *ganglion infraœsophageum* being absent.

2. The thoracic division consists of a large ganglion containing five pairs of nuclei; it is divided into two parts:—an anterior and smaller one, corresponding to the *ganglion infraœsophageum* and to the first thoracic ganglion

* Abstract, communicated by the Author, of a memoir printed in Russian, St. Petersburg, 1878.

† C. Th. von Siebold, 'Lehrbuch der vergleichenden Anatomie,' Th. i. (Berlin, 1848), p. 582.

of other insects; and a posterior and larger part, which corresponds to the other thoracic ganglia and to some abdominal ganglia. The anterior division supplies nerves to the organs of the mouth (like the *ganglion infraœsophageum*) and to the first pair of legs. The posterior and larger division of this ganglion supplies nerves to the second pair of wings, to the thorax, and to different segments of the abdomen.

3. The abdominal division of the nervous system consists of one abdominal ganglion, situated in the last third of the body. It is oval, and is connected with the thoracic ganglion by means of a long and thin cord. From this ganglion spring three pairs of nerves, of which the first and second pairs branch out in the fifth and sixth segments of the abdomen, while the last pair branch out in the last segment of the abdomen and in the rectum.

This nervous system is as curious as that of some Coleoptera* (*Rhizotrogus solstitialis*, *Serica brunnea*) and some Hemiptera (*Hydrometra lacustris*), as it has no *ganglion infraœsophageum*.

LIII.—*Account of the Reptiles and Batrachians collected by Mr. Edward Whymper in Ecuador in* 1879–80. By G. A. Boulenger†.

The collection of Reptiles and Batrachians kindly placed in my hands by Mr. Whymper, though containing no striking novelties, is interesting on account of the care bestowed by its collector in recording the exact locality from which every specimen was obtained. I will therefore mention all the specimens contained in this collection. Four species appear to be new to science.

REPTILIA.

Chelonia.

1. *Cinosternon*, sp.

Two very young, dried specimens, the dorsal shield 24

* Ed. Brandt, 'On the Nervous System of the Lamellicornia,' St. Petersburg, 1878 (in Russian).

Ed. Brandt, 'Researches into the Comparative Anatomy of the Nervous System of the Hemiptera,' St. Petersburg, 1878 (in Russian).

† This paper was ready for the press in November 1881; but the execution of the woodcuts has delayed its publication. In the meanwhile the descriptions of the new frogs have been published in the British-Museum 'Catalogue of Batrachia Ecaudata.'

millim. long, too small and too badly preserved to be properly identified. From Nanegal (3000 feet).

These tortoises are closely allied to *C. leucostomum*, A. Dum., which occurs in Colombia; but the axillary and inguinal shields are in contact, as in *C. integrum*, Leconte, from Mexico.

This is, I believe, the first time that a *Cinosternon* is recorded from Ecuador.

Lacertilia.

2. *Gymnodactylus caudiscutatus*, Gthr.

Guayaquil. One half-grown specimen.

3. *Anolis chrysolepis*, Dum. & Bibr.

Tanti (2000 feet). One ♀ specimen.

4. *Anolis de Villei*, Blgr.

Nanegal (3000 feet). One ♂ specimen.

5. ?*Anolis squamulatus*, Peters.

Anolis squamulatus, Peters, Monatsb. Ak. Berl. 1863, p. 145; Bocourt, Miss. Sc. Mex. pl. xiv. fig. 21.

Milligalli (6200 feet). One ♀ specimen, measuring from snout to vent 65 millim.

As regards the pholidosis and proportions of the head, this specimen agrees perfectly with Bocourt's figure. The ventral scales are smooth, as stated by the latter, though Peters says "Bauchschuppen rund, glatt oder deutlich gekielt." It differs from Peters's description in the following points—median dorsal scales not keeled, smaller size, coloration: this is dull lilac, minutely and indistinctly speckled with blackish. *A. squamulatus* is known from Puerto Cabello and Panama.

6. *Liocephalus trachycephalus*, A. Dum.

Five specimens from Otovalo (8460 feet), one from the road from Quito to Guallabamba (8500 feet), two from the road between Guallabamba and Guachala, one from Ambato (8630 feet), thirteen from Machachi (9000–10,000 feet), two from La Dormida, Cayambe mountain (10,000 feet), and one from Hac. S. Rosario (10,360 feet), on the lower slopes of Illiniza.

7. *Liocephalus iridescens*, Gthr.

Guayaquil. One specimen.

[Of the genus *Liocephalus* five species, two of which are recent additions to science, are known from Ecuador. They may be distinguished in the following way :—

I. Ventral scales smooth, or nearly so.
  1. Palpebral shields small; all the head-shields keeled.
    Dorsal scales large, very strongly keeled; three of them, taken from the middle of the side, correspond to the vertical diameter of the ear-opening .. *ornatus*, Gray.
    Dorsal scales moderate; four of them correspond to the vertical diameter of the ear-opening .... *trachycephalus*, A. Dum.
  2. A series of broad palpebral shields; head-shields smooth, or slightly keeled.
    Front edge of the ear slightly toothed; scales of the lower surface of the tail strongly keeled.................. *iridescens*, Gthr.
    Front edge of the ear rather strongly toothed; scales of the lower surface of the tail feebly keeled .... *formosus*, Blgr.
II. Ventral scales very strongly keeled; head-shields large........................ *aculeatus*, O'Shaughn.]

8. *Ameiva sexscutata*, Gthr.

Tanti. Two specimens (♀ and h.gr.).

9. *Cercosaura Gaudichaudi* (Dum. & Bibr.).

Five specimens from Hac. Olalla, plain of Tumbaco (8490 feet), three from Chillo (9000 feet), and one from Pichincha (11,000 feet).

10. *Proctoporus unicolor* (Gray).

Three specimens from Hac. Olalla, and four from Chillo. A small median occipital shield is frequently present.

11. *Amphisbæna fuliginosa*, L.

One specimen from Guayaquil, and another from Tanti.

Ophidia.

From the interior of Ecuador Mr. Whymper obtained only two snakes, belonging to two species, viz. *Liophis alticolus* and *Leptognathus nebulatus*; and he observes :—"The most intelligent persons I could question declared that snakes did not exist; and the surprise and curiosity which these two specimens excited amongst the natives showed that they were rare." In his paper on the reptiles collected by the Orton expedition Prof. Cope mentions no less than nine species of

snakes from the "valley of Quito." This is in contradiction with what Orton himself says:—"During a residence of nearly three months in the Quito valley we saw but one snake" ('The Andes and the Amazon,' English edition, p. 107).

12. *Boa constrictor*, L.

Guayaquil. One young specimen.

13. *Homalocranion melanocephalum* (L.).

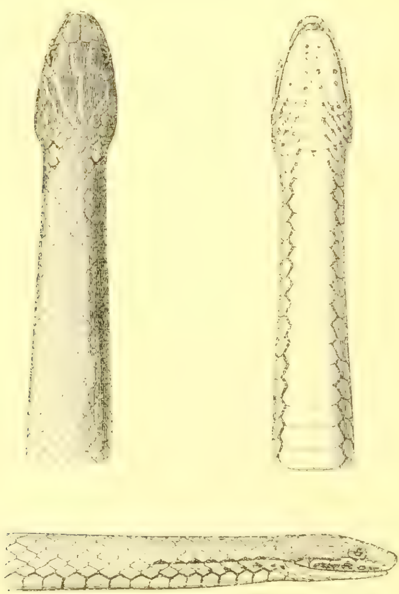
Milligalli (6200 feet). One specimen.

14. *Coronella doliata* (L.), var. *formosa*, Jan.

Guayaquil. One specimen, with undivided anal and twenty-three rows of scales.

15. *Coronella Whymperi*, sp. n.

Habit of *Coronella austriaca*. Head moderate; snout short,



Coronella Whymperi, Blgr.

its length not quite twice the diameter of the eye. Rostral moderate, not advancing on the internasals; latter longer than broad; frontal as long as its distance from the tip of the snout, its front edge nearly straight; parietals longer than frontal, narrowed and including a considerable notch behind. Eight supero-labials, fourth and fifth entering the eye; one preocular, two postoculars, lower smaller than upper; a single anterior temporal; eight inferior labials, five in contact with mentals; latter, hinder pair longest. Scales in seventeen rows. Gastrosteges 154 or 156; anal bifid; urosteges 55 or 66. Brown above, upper half of supero-labials yellowish, lower half blackish; a black streak from the eye along the side of the neck; a light black-edged spot on each side of the nape; a rather indistinct, interrupted, yellowish line along each side of the front half of the body, between the fifth and sixth rows of scales; a black stripe along the middle of the tail and of the hind part of the back; yellow or brownish-yellow beneath; outer edge of gastrosteges and urosteges, and sometimes front edge of former, black.

Length of the two specimens:—Head and body 514, 410 millim.; tail 127, 135 millim.

Milligalli. Two specimens.

This species bears a close resemblance to *Coronella decorata*, Gthr. (Cat. Colubr. Sn. p. 35), from Mexico, but differs in the narrower internasals, shorter tail, size, and coloration.

[Having compared the type specimens of *C. decorata*, Gthr. (1858), with the figure of *Enicognathus vittatus*, Rapp, MS. (Jan, Arch. per la Zool. ii. fasc. ii. p. 61, 1863; and Iconogr. gén. Ophid. livr. 16, pl. ii.), I am convinced that the two species are identical.]

16. *Liophis reginæ* (L.), var. *albiventris*, Jan.

Two adult and two young from Milligalli, and one half-grown from Tanti.

The var. *quadrilineatus*, Jan, is represented by two specimens, which are evidently the adult state of var. *albiventris*.

17. *Liophis alticolus.*

Opheomorphus alticolus, Cope, Proc. Ac. N. S. Philad. 1868, p. 102.

Olalla, near Tumbaco (8490 feet). One fine specimen, which was brought in to Mr. Whymper alive, and excited much curiosity amongst the natives.

18. *Liophis splendens*, Jan.

Hacienda of Palmira, Nanegal (3000 feet). One specimen.

19. *Herpetodryas brunneus*, Gthr.

Guayaquil. One specimen.

20. *Oxyrhopus clœlia* (Daud.).

Hacienda of Palmira, Nanegal. One specimen, with only seventeen rows of scales, and without loreal shield.

21. *Oxyrhopus petalarius* (L.).

Guayaquil. One specimen.

22. *Himantodes cenchoa* (L.).

Guayaquil. One specimen.

23. *Elaps marcgravi*, Wied, var. *ancolaris*, Jan.

Nanegal. One specimen.

24. *Elaps lemniscatus* (L.).

Guayaquil. One specimen.

25. *Leptognathus nebulatus* (L.).

Ibarra (7300 feet). One half-grown specimen, which was brought in to Mr. Whymper alive.

26. *Bothrops atrox* (L.).

Two young specimens from Nanegal, and another from Mindo, W. of Quito (4150 feet).

27. *Bothrops Schlegeli* (Berthold).

Two adult specimens from Bologna, and two young from S. Domingo de los Colorados.

I do not think that *Lachesis nitidus*, Gthr. (1859), is specifically different from *Trigonocephalus Schlegeli*, Berthold.

BATRACHIA.

Ecaudata.

28. *Prostherapis Whymperi*, sp. n.

Snout depressed, projecting, truncate, with angular canthus rostralis; loreal region nearly vertical; nostril nearer the tip of the snout than the eye; the greatest diameter of the orbit equals the length of the snout; interorbital space broader than the upper eyelid; tympanum perfectly distinct, two thirds the breadth of the eye. First and second fingers equal; toes

quite free; disks of fingers and toes small; subarticular and inner metatarsal tubercles indistinct; no outer metatarsal

Prostherapis Whymperi, Blgr.

tubercle. The hind limb being carried forwards along the body, the tibio-tarsal articulation marks the anterior border of the eye. Skin everywhere perfectly smooth. Blackish; throat and belly marbled with grey; lower surface of hind limbs greyish, of arms whitish. An internal subgular vocal sac. From snout to vent 24 millim.

Tanti, 2000 feet. A single (♂) specimen.

This small frog is closely allied to *P. inguinalis*, Cope, hitherto the unique species of the interesting genus *Prostherapis*, Cope. The British Museum having recently received the latter from Ecuador (Sarayacu and Canelos) through Mr. Buckley, I have been able to compare it with this new form; and I have no doubt they are perfectly distinct from each other. In *P. inguinalis* the tympanum is hidden, the first finger is longer than the second, the digital expansions are larger, there is an outer metatarsal tubercle, and the upper lip is margined with white.

29. *Dendrobates tinctorius* (Schneid.).

Two specimens from Tanti.

30. *Phryniscus lævis*, Gthr.

Four specimens collected on the road from Latacunga to Machachi (9000–10,000 feet); five young from the Panecillo, Quito (9500 feet); one young from Hacienda of Guachala (9200 feet); and an adult from Riobamba (9000 feet).

Of this frog, Mr. Whymper says it "is one of the most widely distributed, I think *the* most widely distributed, in

Ecuador. I have seen it almost everywhere from 7000 feet above the sea to 13,500 feet. We could have obtained thousands of specimens if there had been any object in doing so."

31. *Phryniscus elegans*, sp. n.

Phryniscus elegans, Blgr.

Head small, its length nearly one third that of the body; snout prominent, truncate, not pointed, a little longer than the diameter of the eyeball; canthus rostralis angular; loreal region vertical; rostral nearer the tip of the snout than the eye; interorbital space broader than the upper eyelid. Limbs slender; stretched along the body, the fore limb extends beyond the vent with the length of the fourth finger, the hind limb marks the middle of the eye with the tibio-tarsal articulation. Fingers slightly webbed at the base, first very short; toes nearly entirely webbed, the last two phalanges of fourth toe free; inner toe very short, but perfectly distinct; no subarticular, nor carpal, nor metatarsal tubercles. Skin perfectly smooth. Light pinkish grey above, vermiculated with broad black lines; a black streak from the tip of the snout, through the eye, along each side of the body to the groin; lower surfaces white, immaculate, except a few small black spots under the limbs. From snout to vent 34 millim.

A single ♀ specimen from Tanti.

32. *Hylodes conspicillatus*, Gthr.

Two specimens (♂ and young) from Milligalli, 6000 feet.

33. *Hylodes unistrigatus*, Gthr.

Eight specimens from the neighbourhood of Machachi (9000 to 10,000 feet), one from Chillo (9000 feet), and three from Hacienda of Olalla, plain of Tumbaco (8490 feet).

34. *Hylodes Whymperi*, sp. n.

Hylodes Whymperi, Blgr.

Habit of *Hyla arborea*.

Tongue oval, entire. Vomerine teeth in two oblique series behind the choanæ. Snout rounded, as long as the greatest orbital diameter, with distinct canthus rostralis; nostril nearer the tip of the snout than the eye; interorbital space a little broader than the upper eyelid; tympanum hidden. Fingers moderate, first shorter than second; toes moderate, quite free; disks and subarticular tubercles moderate; two metatarsal tubercles. The hind limb being carried forwards along the body, the tibio-tarsal articulation reaches the angle of the mouth. Skin of upper surface tubercular; on the back the tubercles are confluent into more or less distinct longitudinal lines; belly granulate. Dark olive-brown above (in one specimen with a few light spots); greyish or reddish brown, immaculate or marbled with dark brown, beneath; upper lip whitish. In the specimen from the valley of Collanes and in that from the mountain Cotocachi the front and hinder sides of the thighs are tinged with magenta red. From snout to vent 27 millim.

H. Whymperi resembles *H. unistrigatus* in general appearance; but the latter has a distinct tympanum, larger digital

expansions, the skin smooth, or nearly smooth, above, and a strong fold across the chest.

Two specimens from Pichincha (11,000 to 12,000 feet), one from the valley of Collanes (12,500 feet), one from Cotocachi (13,000 feet), and two from Tortorillas, lower slopes of Chimborazo (13,200 feet).

Besides these three well-characterized *Hylodes* there are eleven very small specimens from Chillo, 9 to 15 millim. long from snout to vent, too young to be properly determined. Upon these Mr. Whymper observes, "This miniature species was first brought to my notice by an English resident; and he assured me that the largest of the specimens represents the full size of the species." This is evidently a mistake, as all the specimens prove to be young. They perhaps belong to a new species; but with the materials before me I will not venture to describe it.

35. *Bufo cæruleostictus*, Gthr.

A male specimen. Nanegal, 4000 feet.

36. *Bufo marinus* (L.).

Two very young specimens, from near the bridge of Chimbo (1000 feet).

37. *Bufo crucifer*, Wied.

Two half-grown specimens, from Tanti.

38. *Nototrema marsupiatum* (Dum. & Bibr.).

Thirty-one specimens from the neighbourhood of Machachi, and eight from the neighbourhood of Hacienda of Antisana, 13,300 feet; six tadpoles from Pedregal, 11,600 feet.

Mr. Whymper informs me that the ground-colour was bright green. "These frogs were in great numbers at this locality (Machachi); and in the evening their music was so loud as almost to interfere with hearing when walking out."

Apoda.

39. *Cæcilia pachynema*, Gthr.

One specimen from Milligalli.

Maxillary teeth 5, mandibular 4, vomero-palatines 6; circular folds 160. Unspotted.

The following is a list of the papers treating especially of the herpetological fauna of Ecuador:—

A. Günther, "Lists of the Cold-blooded Vertebrata collected by Mr. Fraser in the Andes of Western Ecuador," Proc. Zool. Soc. 1859, pp. 89, 402–420, pl. xx.

E. D. Cope, "An Examination of the Reptilia and Batrachia obtained by the Orton Expedition to Ecuador and the Upper Amazon, &c.," Proc. Ac. Philad. 1868, pp. 96–119.

Also Orton "Contributions to the Natural History of the Valley of Quito: Reptiles," Amer. Natur. 1871, v. p. 693.

J. de la Espada, 'Viaje al Pacifico, Vertebr., Batr. an.' Madrid, 1875, 4to, 208 pp. 7 pls. Preliminary Diagnoses of the new species have been published in Jorn. Sc. math. phys. e nat. Lisb. ix. 1870, pp. 58–65, and An. Soc. Esp. i. 1872, pp. 85–88.

G. A. Boulenger, "Reptiles et Batraciens recueillis par M. E. de Ville dans les Andes de l'Equateur," Bull. Soc. Zool. France, 1880, pp. 41–48, and P. Z. S. 1881, pp. 246 & 247, pl. xxvi.

A. W. E. O'Shaughnessy, "On the Collection of Lizards made by Mr. Buckley in Ecuador," P. Z. S. 1880, pp. 491–493, pl. xlix., and 1881, pp. 227–245, pls. xxii.–xxv.

LIV.—*Charles Darwin.* By M. de Quatrefages*.

At the last meeting our honourable President was good enough to give me notice that he would call upon me to-day to say a few words with reference to the scientific labours of Darwin. I could only answer that he was imposing upon me a very difficult task, and that it is not in a short note that one can

* Translated from the 'Comptes Rendus de l'Académie des Sciences,' 1st May, 1882, pp. 1216–1222. We have thought that a translation of this memoir, although it contains little that has not appeared in many notices of the great English naturalist, might be of interest to our readers for several reasons. It is not only an expression of opinion upon Darwin's character and work by a distinguished foreign zoologist: but it was prepared at the special request of the President of the French Academy of Sciences; and some parts of it are of particular interest in connexion with the fact of Darwin having been rejected as a Correspondent of the Institute, although subsequently elected. Further, M. de Quatrefages, with many French naturalists, stood in opposition to the theory of the origin of species by descent with modification, as enunciated by Darwin; and we have here a brief exposition of his views upon this subject, and side by side with this a statement of those considerations which seem to him to establish the preeminent merit of the great philosopher whose loss is here commemorated, quite independently of the acceptance or rejection of his theory.

appreciate and render intelligible a very considerable mass of researches, bearing upon a multitude of the most diverse subjects, and especially a doctrine the profound influence of which has made itself felt, not only in the domain assigned to the natural sciences, but, it may be said, in almost the entire field of human thought. Nevertheless I would not draw back from an appeal by which I considered myself honoured.

My own past in a manner made it a duty for me to answer. I have openly combated the doctrines of Darwin, which have been so popular; but I have always as openly rendered justice to the man and to the philosopher. The Academy knows that from the first to the last candidature of our regretted correspondent, neither my vote nor my words have been wanting in his support. Incited by our President, I cannot be silent today. I shall therefore endeavour to summarize, in as few words as possible, the general impression which is left upon my mind by a career, few like which are to be found in the annals of science.

There were two men in Charles Darwin—a naturalist, observer, and experimenter when necessary, and a theoretical thinker. The naturalist is exact, sagacious, and patient; the thinker is original, often correct, but also often too rash. It is this rashness that led Darwin into paths where many less adventurous naturalists could not follow him. But are we, on this account, to forget that before he strayed in this manner, and, indeed, in the midst of his most imprudent wanderings, he discovered and opened out daily some new course, in which the most circumspect of men now march after him?

Darwin never specialized himself. To judge of his entire scientific work one must be a geologist and a botanist quite as much as a zoologist. Being unable by myself to give a detailed (*motivé*) judgment upon a great part of his works, I shall limit myself to recalling the proofs of high estimation which have been accorded to them by the most competent authorities. These indisputable testimonies will not fail me.

On the 27th December, 1831, Darwin (then twenty-two years old) embarked on board the 'Beagle,' which, under the command of Captain Fitzroy, was starting upon a voyage round the world. He returned to England after a five-years' expedition, and immediately commenced a series of publications, which very quickly secured him a special place among the naturalists, his compatriots.

We must first say a word about his "Journal" of the voyage. One hears too little of this book, in which we can already see traces of some of the ideas which the author was afterwards to develop, and which contains a multitude of details, some of

which are very important. Whether the question is of man, of animals, or of plants, Darwin shows himself a careful and sagacious observer, capable of rapidly seizing upon relations, even though they may be distant, and to bring out their consequences. He also appears as a man of generous thoughts. The extermination of the Tasmanians calls from him a cry of indignation, which, it may be said to the honour of Englishmen, was repeated by many of his compatriots.

Our Correspondent was charged with the conduct of the publication of the scientific results obtained by the expedition of the 'Beagle.' His co-labourers were Owen, who described the fossil Mammalia; Waterhouse, who published the recent Mammals. Gould undertook the birds; but, being sent into Australia, he left this work to Darwin, who obtained the aid of Gray, as it is hardly necessary to say. However, two great memoirs, called "Introductions," one upon geology considered in its relations with the extinct mammalogical species, the other on the geographical distribution of the recent Mammalia, attest the knowledge he possessed of these groups and his aptitude for the treatment of general questions.

Darwin did not recoil from the minute investigations which are required for the knowledge and discrimination of species. This he has well proved by the manner in which he has monographically treated the history of the Cirripedes. Before his time there existed upon this class scarcely any thing but scattered materials, and the characterization of the groups was not sufficiently advanced to permit geologists to take advantage of the fossils of this kind buried in various strata. Darwin devoted three volumes, representing more than 1200 pages, to the investigation of the recent and fossil Cirripedes. These works were printed at the cost of the Ray and Palæontographical Societies. This is enough to prove their value; for Darwin was as yet only the *Naturalist of the 'Beagle,'* and it was not to his future reputation, which there was nothing at that time to foretell, that so significant a homage could be paid.

However, at first, it is towards the history of our globe that Darwin's thoughts appear to have been directed in preference. At the time of the publication of the scientific results of the 'Beagle's' voyage, he undertook single-handed the geological part, which includes several volumes. He inserted in these or published elsewhere a great number of memoirs or notes, among others upon coral islands, on the formation of volcanic islands, on the geology of the Falkland Islands, on the various geological phenomena which were manifested in South America, &c. These diverse publica-

tions procured him, from the Geological Society of London, the Wollaston Medal, the highest recompense at the disposal of that Society*.

Subsequently botany especially attracted Darwin's attention —not descriptive botany, but rather that part of the science which deals with obscure and little-known phenomena, belonging especially to physiology. We know what importance the most highly-qualified naturalists attach to his observations and experiments upon polymorphism, on the intercrossing of different forms of the same species, on climbing plants, on the fertilization of orchids, &c. The eminent botanist Hooker, in a public discourse, declared that the physiological discoveries of Darwin were the finest that had been made for ten years. Our illustrious fellow-member M. de Candolle has never hidden his admiration for the English naturalist; and in a letter, which I could find if necessary, he wrote to me, with that extreme modesty which we all know him to possess, nearly in the following words:—"It is not I, it is Darwin that the Academy should have named as its foreign associate."

And yet it is not this group of works, all precise, all correct, all bringing to science results thenceforward acquired, which have gained for Darwin his immense reputation and his widespread popularity. It was his theory of the Origin of Species that taught the whole world, the ignorant as well as the learned, the name of the illustrious Englishman. It is because this theory seemed to respond to one of the most vivid aspirations, and, I do not hesitate to say, one of the noblest desires of the human mind; it is because it seemed to explain the world of organized beings, just as mathematics, astronomy, geology, and physics have explained the world of inorganic bodies. What Darwin attempted was to refer to the action of second causes alone the marvellous group of phenomena studied by the botanists and the zoologists; he endeavoured to explain their genesis and evolution, just as the astronomers and geologists have taught us how our globe originated, and how its surface has become what we see it.

There is nothing but what is perfectly legitimate in this great effort of a great mind; and it cannot be but that Darwin's conception has in it something serious as well as seductive to enable it to carry away not only the multitude who take things on credit, and too often under the influence of their passions, but also such men as Hooker, Huxley, Vogt, Lubbock, Brandt, Philippi, Häckel, Lyell, and so many others.

The fact is that Darwin's starting-point is unassailable. No

* [It was, at the time, not merely the highest, but the *only* honour the Society had to bestow.]

one nowadays, I fancy, would dream of denying the perfect truth of what the English naturalist has said about the struggle for existence and natural selection. Up to this point he remained upon the solid ground of observation and experiment. Afterwards these two guides of modern science suddenly fail him. Seeking to explain the origin of species, he does not ask himself what is to be understood by that word. I am not going to inquire here what is the true notion that we ought to form of this fundamental group. But it was necessary that, having to speak of it, Darwin should form some precise idea of it. This he has not done; and this is how he has fallen into the course which led him into error. It is as if a traveller following a safe though arid road, should quit it, seduced by the mirage, and lose himself in the open desert.

But such a traveller, however he may go astray, may discover, in the midst of the sandy wastes, rich oases the existence of which he will reveal. And this has been Darwin's destiny. It is precisely under the influence of ideas that I cannot accept, that he undertook and brought to an end some of his most curious and most important works—works of which, no doubt, he would never have thought, if he had followed a more regular course.

The question which pressed itself most imperiously upon Darwin is one of those which have occupied the greatest minds, Geoffroy Saint-Hilaire, as well as Buffon; I mean the variability of the species. It constitutes the basis of the doctrine of the English naturalist; he is incessantly occupied by it, and seeks it always and everywhere in the two organic kingdoms. It is by virtue of this special point of view that he was enabled to notice many facts which had escaped his predecessors; that he made experiments of which no one else had dreamt; and that he attained unexpected but very positive results, which physiology, botany, and zoology will henceforward have to take into account. It is here that we find the original work of Darwin—the work that assures him a position apart, and in the highest rank, among naturalists; and, what is remarkable, there is in this work instruction for every body. Nowhere shall we find graver arguments to combat the transformist doctrines which have themselves given rise to these very investigations. On the other hand, nowhere shall we meet with more solid arguments to oppose to exaggerated morphologists. It will be understood that I cannot here develop all my thoughts; but I do not think that I exaggerate in saying that, for a long time and perhaps always, whoever shall take up those general questions to which I allude, must, in the first place, study the writings of Darwin.

These I cannot enumerate here. Moreover, some of them are beyond my range. I shall only refer to the two volumes devoted to the study of variation in animals and plants under the influence of domestication; and in the midst of the mass of facts, observations, and experiments contained in their thousand pages, I shall only dwell for a moment upon the memoir upon pigeons.

This work required of Darwin ten years of investigations. In order to bring together the materials for it he procured specimens of all the known races of pigeons; he even prepared with his own hand their skeletons, which he has described almost bone by bone. From this study of their external and osteological characters he concluded that these domestic birds, called indifferently by the same name, present, at least, 150 more or less distinctly marked forms, all perpetuating themselves by generation, and capable of being taken for so many species if they were met with living in freedom. These forms are, moreover, so different that, if we were to apply to them the rules of classification employed in the distribution of species, we must form for them five distinct genera.

In presence of so great a diversity Darwin asked himself whether all these apparent species can be referred to a common initial form; or whether, as Buffon and Cuvier himself had thought, several wild species had mingled their blood to engender what we call the domestic pigeons. Now, by an entire series of exact facts and rigorous deductions he succeeded in showing that all our pigeons have descended from the rock-dove, *Columba livia* of naturalists. Then he checks by experiment this result deduced from observation. He couples the most dissimilar forms; he accumulates in the same subjects the blood of the representatives of the five supposed genera, of which I spoke above; and he finds that these complex products lose none of their fertility. Finally, as a countercheck, he couples these pigeons with species other than the rock-dove, and demonstrates the disappearance of fecundity.

Nothing can be clearer than the consequences which result from this arduous labour. The species may vary almost indefinitely in the forms of its representatives without losing its fundamental character, namely the faculty of reproducing itself. The physiological separation of species, even when very nearly allied, is just as clearly demonstrated by these experiments. All these facts are in absolute contradiction with the very basis of the theory which assumes the evolution and the transmutation of the species. Does Darwin, therefore, deny or misrepresent them? Certainly not; and it is

here that is displayed in the fullest light a trait of character and intellect that I must at least indicate, unless I would leave a serious hiatus in this too rapid sketch.

The enthusiastic disciples of Darwin assert that he has explained every thing in the organic world. The language of the master is quite different. No doubt he allows himself too frequently to be carried away by the vivacity of his thoughts. Nevertheless, also very frequently, he retains sufficient coolness to recognize, even in his own works, the arguments and facts which are in favour of his adversaries. Then he hastens to indicate them with a loyalty which has something chivalrous about it. He is the first to declare that he knows nothing about the appearance of the archetype, the ancestor of all organized beings; he rejects, as being in disagreement with the results of experiment, the belief in spontaneous generation, which would so easily have completed his doctrine; he recognizes that the struggle for existence and natural selection cannot explain the appearance in an organism of any thing really new; he makes the same avowal with regard to the unfertility which must at some given moment physiologically separate forms issuing from the same stock and convert them into distinct species. This constant good faith gives to some of Darwin's pages a peculiar charm. We follow with interest, even in his mistakes, this thinker, who is entirely occupied in the endeavour to make us adopt his beliefs, but who nevertheless places in our hands, with true candour, the arms best fitted to combat him. We put down his books with a great increase of our high esteem for the philosopher, of our affectionate sympathy with the man.

In these almost improvised pages, no more than in my other writings, could I pass in silence over what separates me from Darwin. As on all other occasions, I have done it with regret. On the other hand, it is from the bottom of my heart that I have tried to render him a last and just homage.

In acting thus it seems to me that I must find myself in accord with the general sentiment of the Academy. At first the Academy did not favourably receive Darwin's candidature as a Correspondent. It has been reproached for this by some of the adherents of the English naturalist; but unjustly. For them Darwin's merit consisted especially in his theory. By its first hesitation the Academy showed that it could not join in this judgment. Then, by welcoming the author of the book 'On the Origin of Species,' it proved that it had been able to recognize all that was important and durable in the complex work of the illustrious naturalist, and to render justice to his true merits. It has therefore in all particulars

fulfilled its duties as a scientific tribunal with high impartiality.

Now, Darwin is dead; and most certainly no one within these walls has withheld sincere and cordial regrets from this true and great naturalist, who chose to pass his whole life, solely devoted to study and meditation, in a modest retreat, far from the honours which it would have been so easy for him to attain, and which came to seek him when he could no longer avoid them.

MISCELLANEOUS.

Three more Freshwater Sponges.

Mr. Edw. Potts had described in the Proceedings under date of July 26, 1881, a new species of *Carterella*, *C. latitenta*; his later identified findings during that year are here mentioned.

Meyenia crateriforma.

This sponge, first found during September 1881, in the Brandywine, near Chadd's Ford, is of very delicate structure. Its framework of skeleton-spicules is exceedingly meagre and slightly bound together, scarcely amounting to a system of meshes and polyhedral interspaces, as in most other sponges; and, as a consequence, we find the numerous small white statospheres lying in recesses far larger than themselves, freely exposed to view from the upper or outer side of the sponge. This trait is only seen in the thinnest of incrusting sponges.

The skeleton-spicules may be described as acerate, gradually sharp-pointed, sparsely and very minutely microspined. With these were mingled smaller and more slender forms, which may be an earlier stage of the same, or perhaps are dermal spicules; but beside these may be seen upon the undisturbed surface of the sponge two other forms—one, cylindrical, slender, with truncate ends, the other similar in all respects to the long birotulates which surround the statospheres. The last have most probably been displaced from their normal position.

The birotulate spicules surrounding the statospheres, as compared with those of any other described sponges, and with the diameter of their own rotules, are relatively very long. The diameter of the complete statosphere is to that of the contained chitinous body about as ten to seven; and the diameter of the rotules, while perhaps double that of the shafts, is only from one fifth to one seventh of their length. A number of long sharp spines occur near each extremity of the shaft. These birotulates are disposed, as is usual, very regularly and densely upon the surface of the chitinous body—

one end of each being thus supported, the other forming a second or outer coat or surface. One peculiarity, however, of their arrangement has suggested the specific name now given. In most other species the length of the foraminal tube is fixed, or approximately indicated, by the thickness of the spiculiferous coat, which closes up around and against it. In this, however, on account of the unusual length of the spicules and their necessary radial direction, a space is left about the foramen, in the centre of which the tubule appears as an elongated cone, the whole having the appearance of a volcanic crater. In mounted specimens, probably as a result of violence in making sections of the statoblasts, these spicules frequently deviate from a direct radial position and cross each other's lines in a curious manner. This sponge has also been found in the Schuylkill river and in some of its smaller branches.

Heteromeyenia Ryderii.

This beautiful green sponge has, as yet, only been found in a branch of Cobb's Creek, a small stream whose waters reach the Delaware river, below Philadelphia. It occupied the upper surface of large stones in the bed of the stream, some of the patches being 4 or 5 inches in diameter and about one fourth of an inch thick. The surface is somewhat irregular, occasionally rising into rounded lobes. The efferent canals are deeply channelled in the upper surface of the sponge, five or six sometimes converging to a common orifice.

The skeleton-spicules are stout, cylindrical, slightly curved, gradually sharp-pointed, conspicuously spined, excepting at the extremities; spines conical, sharp-pointed, when largest often curving forward or towards the adjacent ends of the spicules. As is generally the case with spined skeleton-spicules, they are but slightly fasciculated — being mostly arranged in a simple series, single spicules meeting or diverging from other spicules, thus forming a delicate network, supporting the sponge-flesh. With these are mingled a few more slender smooth spicules, which may be immature, or the true dermal spicules of the sponge.

The statospheres are numerous, rather small, surrounded *first* by a series of birotulates, short, stout, the rotulæ about equal in diameter to the length of the shaft. The shafts are cylindrical or somewhat wider towards the rotules, having frequently one or more long spines near the centre. Margins of the rotulæ marked with an infinity of shallow cuts not amounting to notches.

The *second* series of birotulates, which, more than in either of the other species of this genus, marks this as a deviation from the familiar *Meyenia* type, are very different from the first. They are nearly double the length of the former, much fewer in number, rather regularly interspersed among them; the rotules are represented by six, eight, or more short recurved hooks at each end of the shaft, which is cylindrical and studded with numerous spines equal in length to the hooked rays of the rotulæ, and curving, like them, from the extremities. This species is respectfully dedicated

by the discoverer to his friend Mr. John A. Ryder, in acknowledgment of much excellent advice, assistance, and encouragement.

Tubella pennsylvanica.

The genus *Tubella*, as established by Mr. H. J. Carter, February 1881, was represented by four species, three originally described by Dr. Bowerbank (as Spongillas), and one by Mr. Carter, all collected in the Amazon river, South America. It does not appear that any have been described from other localities. It was therefore with much pleasure and some surprise that, while examining material collected at Leheigh Gap, Pa., in November last, Mr. Potts came upon undoubted specimens of the same genus. It differs from *Meyenia* in the fact that the rotulæ of the spicules surrounding the statospheres are of unequal diameters, the larger one being placed next the chitinous coat. This species, whose peculiarities do not tally with those of any of the four above mentioned, may be thus described:—

Sponge minute, incrusting, thin; the skeleton-spicules arranged in a simple series of single non-fasciculated spicules, in the interspaces of which the statospheres are abundant.

Skeleton-spicules very variable in size and in shape, but all entirely and coarsely spined; rounded or abruptly pointed at the extremities.

Dermal spicules absent or undetermined.

Statospheres numerous, small; granular coating thin, but extending to or somewhat beyond the outer ends of the birotulates. Length of the inequibirotulates about equal to the diameter of the larger disk, which is placed against the chitinous coat. Margin of larger disk generally entire, subcircular; outer surface flat, table-like, the margin sometimes slightly incurved. This surface is not unfrequently warped or twisted into an irregular outline. The outer disk, in the great majority of cases, is about one fifth of the diameter of the inner, but varies from, say, one sixth to equality, which is, however, rarely observed. Its margin also appears to be generally entire, but it is undoubtedly sometimes divided into six or eight rays. The inner surface of the larger disk is also occasionally marked with rib-like rays; and still more rarely the margin between the rays is wanting.

These, as before stated, are all the species whose novelty has been definitely determined; but amongst the large amount of material collected are doubtless others, belonging to the genera *Spongilla* and *Meyenia*, whose distinguishing peculiarities are less obvious, and where close study will be needed to define them.—*Proc. Acad. Nat. Sci. Philad.*, Jan. 10, 1882, p. 12.

Restoration of the Disk in Ophiurans. By A. E. VERRILL.

That Ophiurans restore their rays with remarkable facility when broken, or entirely lost, is well known. In examining a large series of *Amphiura abdita*, V., collected in the harbour at Noank.

Conn., among eel-grass (*Zostera*), in 1874, I found several specimens in which the entire dorsal disk, with the contained viscera, had been lost and more or less restored, showing the various stages of the process. The dorsal disk of this species is soft and swollen, and is very easily detached. The arms are exceedingly long and slender, and subject to frequent restorations. In some of the examples in which a new disk was forming, the scars are still plainly visible on the bases of the arms, showing where the disk had been torn away, and its former size. In some of these the new disk, though perfect in form, had not grown to more than one third or one half the diameter of the old one; in others it was nearly completed. These small disks, connected with the full-sized arms and jaws of the adult, give such specimens a very peculiar appearance. At first I mistook some of these for the genuine young; but a more careful examination easily revealed their true nature.

In the same lot were specimens in which a portion of the edge of the disk, with one or two of the arms, had been destroyed and afterwards restored. In a few instances two arms had grown out in place of one.—*Amer. Journ. Sci.*, May 1882, p. 408.

On the Abyssal Malacological Fauna of the Mediterranean. By M. Fischer.

The demonstrated existence in the Mediterranean of a deep zone included between 250 and 3624 metres, and characterized by its constant temperature (about 55° F.), lends much interest to the enumeration of the Mollusca that live under these definite thermal conditions. But it is necessary to distinguish the species which inhabit the bottom from those whose shells have fallen from the surface after death. In most of the deep dredgings of the 'Travailleur' we found shells of pelagic Mollusca*, sometimes forming enormous accumulations, but quite incapable of furnishing any notion of the true abyssal fauna. On the other hand, the Gastropoda, the Scaphopoda, the Lamellibranchiata, and the Brachiopoda, in the adult state and with the shell intact, generally lived upon the bottom, whence they were collected by the dredge.

Nothing was known of the Gulf of Lyons below 350 metres. The most productive dredgings in Mollusca off these coasts during the expedition of the 'Travailleur' were at the stations No. 1 (555 metres), 9 (445 metres), and 5 (1685 metres); and the list that we have prepared includes more than sixty species †. Some of

* Cephalopoda: *Argonauta argo.* Pteropoda: *Spirialis physoides, S. bulimoides, Protomedea rostralis, Hyalæa tridentata, H. vaginellina, Cleodora lanceolata, C. cuspidata, Creseis spinifera.* Heteropoda: *Carinaria mediterranea, Atlanta Peronii.* Gastropoda (larvæ): *Sinusigera*, sp.

† Brachiopoda: *Terebratula vitrea, Terebratella septata, Terebratulina caput-serpentis, Megerlia truncata.* Lamellibranchiata: *Lima elliptica, L. subauriculata, L. Sarsi, Pecten Brunei pes-lutræ, P. Hoskinsi, P. fenestratus, Malletia cuneata, Leda messaniensis, L. striolata, Nucula sulcata, Arca lactea, A. tetragona, A. pectunculoides, Limopsis aurita, L. minuta, Dacrydium vitreum, Astarte sulcata, A. triangularis, Venus*

them were indicated long ago in the fossil state in the Pliocene of Italy, such as *Terebratella septata*, *Leda messaniensis*, *Limopsis aurita*, *L. minuta*, *Pleurotoma Loprestiana*, *Columbella costulata*, *Rissoa subsoluta*, *Turbo romettensis*, *Trophon multilamellosus*, &c.; but they also live in the abysses of the Bay of Biscay and on the shores of Portugal.

Between the dredging 1 (555 metres) and the dredging 5 (1685 metres) there is no essential difference from a zoological point of view; the species of dredging 5 all occur in the bottom of dredging 1, but their number is restricted; we have only recognized about twenty *.

The dredgings 18 (2454 metres) and 17 (2660 metres) in the north of the Mediterranean, between Provence and Corsica, have also furnished us with Mollusca which existed at the depth of 555 metres—*Terebratula vitrea*, *Syndesmya longicallus*, *Xylophaga dorsalis*, *Nucula sulcata*, *Nassa Edwardsi*, *Dentalium agile*, &c.

We may conclude that between 445 and 2660 metres the deep-sea malacological fauna has the same zoological characters, but that the number of species gradually decreases with the depth. The equality of temperature has the effect of rendering the fauna almost uniform.

In the south of the Mediterranean the principal stations where Mollusca abound bear the numbers 26 (900 metres) and 28 (432 metres) along the Barbary coast, between Oran and Gibraltar. Here we collected about sixty species †; but some of these do not extend so far as the Gulf of Lyons. The remarkable forms are:—

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multilamella, *Isocardia cor*, *Kelliella miliaris*, *Lucina spinifera*, *Neæra cuspidata*, *N. costellata*, *Xylophaga dorsalis*, *Syndesmya longicallus*, *Pholadomya Loveni*. Scaphopoda: *Siphonentalis quinquangularis*, *Cadulus tumidosus*, *Dentalium agile*. Gastropoda: *Trophon multilamellosus*, *Chenopus Serresianus*, *Buccinum Humphreysianum*, *Nassa limata*, *N. Edwardsi*, *Columbella costulata*, *Marginella clandestina*, *Cerithium metaxa*, *Eulima stenostoma*, *E. distorta*, *Craspedotus Tinei*, *Turbo romettensis*, *Scissurella crispata*, *S. costata*, *Emarginula fissura*, *Odostomia unifasciata*, *Cioniscus gracilis*, *Rissoa abyssicola*, *R. subsoluta*, *Ringicula leptochila*, *Pleurotoma Loprestiana*, *Hela tenella*, *Eulimella ventricosa*, *E. acicula*, *Aclis Walleri*, *Cylichna conulus*, &c.

* *Terebratula vitrea*, *Lima elliptica*, *L. Sarsi*, *Malletia cuneata*, *Leda messaniensis*, *L. striolata*, *Arca pectunculoides*, *Neæra costellata*, *Xylophaga dorsalis*, *Dentalium filum*, *Trophon multilamellosus*, *Hela tenella*, &c.

† Lamellibranchiata: *Pecten vitreus*, *Modiola lutea*, *Limopsis minuta*, *Arca diluvii*, *Nucula sulcata*, *N. ægeensis*, *Lucina borealis*, *L. spinifera*, *Axinus granulosus*, *A. ferruginosus*, *A. biplicatus*, *Astarte bipartita*, *Cardium minimum*, *C. papillosum*, *Venus multilamella*, *V. casina*, *Syndesmya longicallus*, *Neæra abbreviata*, *N. costellata*, *Poromya granulata*, *Saxicava arctica*, *Saxicavella plicata*. Scaphopoda: *Siphonentalis quinquangularis*. Gastropoda: *Murex Spadæ*, *Nassa semistriata*, *Trophon multilamellosus*, *Chenopus Serresianus*, *Taranis Mörchi*, *Pleurotoma Loprestiana*, *Trochus gemmulatus*, *Zizyphinus Folini*, *Z. suturalis*, *Scissurella crispata*, *Natica fusca*, *Rissoa abyssicola*, *Eulima bilineata*, *Eulimella scillæ*, *E. acicula*, *Odostomia conoidea*, *Pyramidella minuscula*, *Actæon exilis*, *Cylichna nitidula*, *Tectura fulva*, *Calyptræa sinensis*, &c.

Modiola lutea, discovered in the Bay of Biscay between 677 and 1960 metres; *Taranis Mörchi*, a boreal species, abyssal in the Atlantic; *Trochus gemmulatus* and *Zizyphinus suturalis*, fossil in the Italian Pliocene, and found living in the Bay of Biscay; and *Tectura fulva*, an arctic mollusk.

Combining the Mollusca of all our deep dredgings (555–2660 metres) we obtain a total of about 120 species; but only thirty of these can be regarded as abyssal *. All the deep-sea species of the Mediterranean without exception occur also in the Atlantic Ocean. It therefore seems to be demonstrated that the Mediterranean receives its deep-sea fauna from the Atlantic, and that there has not been a centre of creation for it. It remains to be ascertained whether the fauna of the superior strata, characterized by a great number of species localized in the Mediterranean, is also derived from the Lusitanian fauna.

The abyssal forms of the Mediterranean have been dredged in the Atlantic generally at considerable depths. The Mediterranean therefore only contains the Mollusca which can bear a rather high temperature. The arctic forms fossilized in the glacial deposits of Sweden and the British Isles appear no longer to exist in the present Mediterranean, although they were abundant there during the newer Pliocene period (deposits of Ficarazzi). The temperature of the Mediterranean has consequently changed gradually; it is probable that it was not then constant, and that a communication with very cold seas brought arctic Mollusca into it. It would be interesting to ascertain whether, in the great depths of the eastern Mediterranean and of the Black Sea, there may not exist some survivors of the glacial fauna of the Pliocene of Ficarazzi.—*Comptes Rendus*, April 24, 1882, p. 1201.

A Zoological Station at Villafranca.

We have received from Dr. J. Barrois an intimation that the French government have recently decided upon establishing a new zoological station at Villafranca, of which the direction will be in his hands. The purpose for which it is specially founded is that of furnishing facilities for the study of the rich marine fauna of the locality, which yields in interest to no other in the Mediterranean, by the many naturalists who may be attracted to Villafranca by the charms of the place and its surroundings; and Dr. Barrois particularly expresses a hope that many English zoologists may be induced to avail themselves of the advantages thus offered to them at a much less distance from home than the older establishment at Naples. Dr. Barrois promises a particularly warm welcome to our countrymen.

* For example, *Terebratella septata, Lima Sarsi, Pecten Hoskinsi, Axinus granulosus, Malletia cuneata, Arca pectunculoides, Leda messaniensis, L. striolata, Limopsis aurita, L. minuta, Pholadomya Loveni, Modiola lutea, Dacrydium vitreum, Dentalium agile, Cadulus tumidosus, Taranis Mörchi, Hela tenella, Pyramidella minuscula, Pleurotoma Loprestiana, Tectura fulva, Columbella costulata, Turbo romettensis, Trochus gemmulatus, Rissoa subsoluta, Eulima stenostoma, Craspedotus Tinei, Trophon multilamellosus*, &c.

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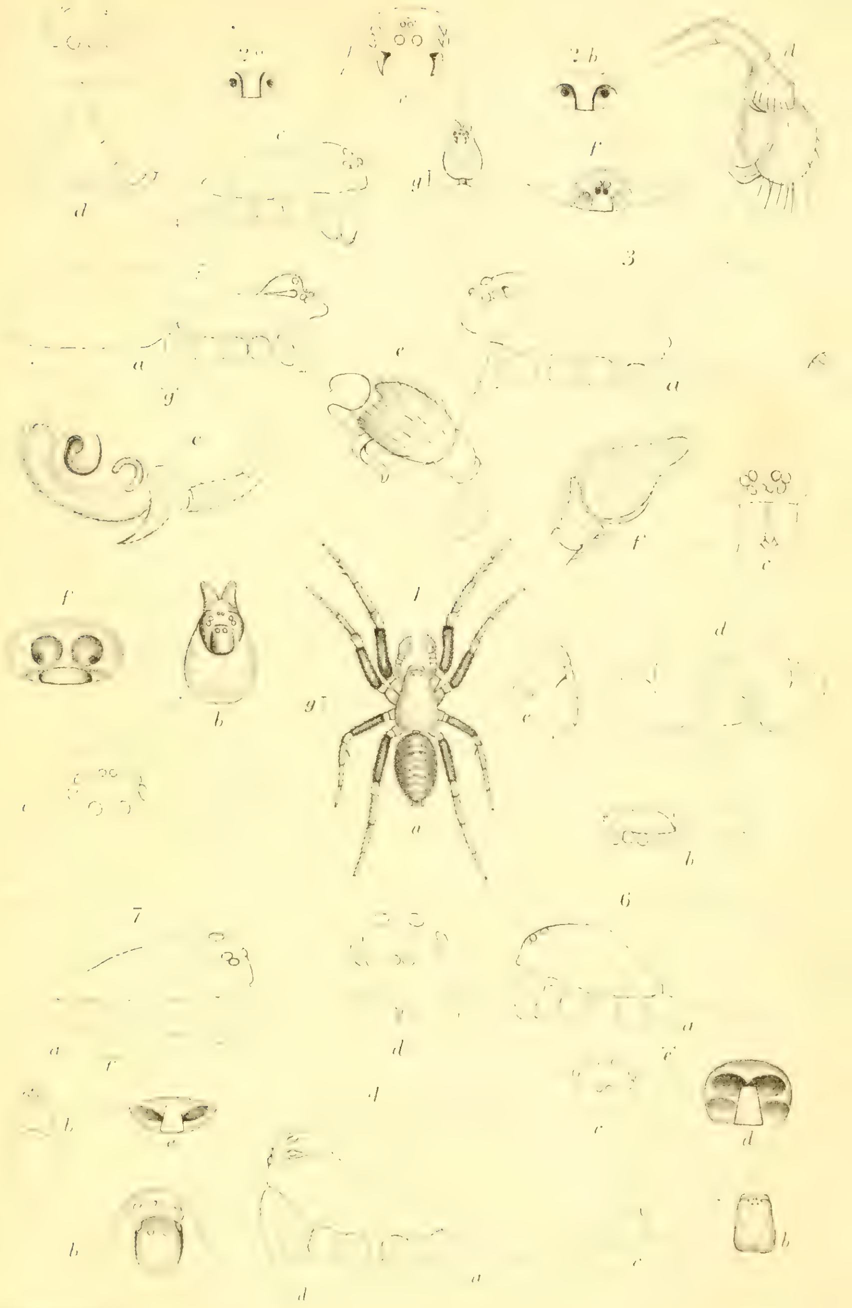

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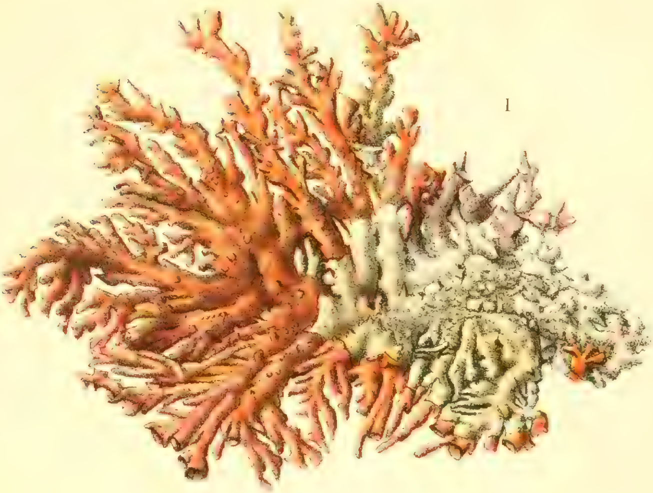

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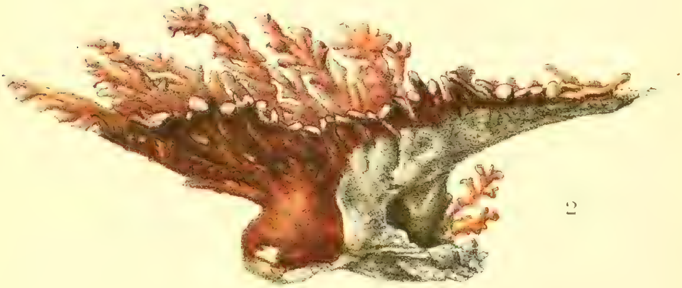

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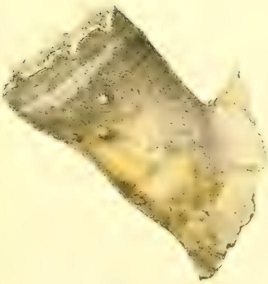

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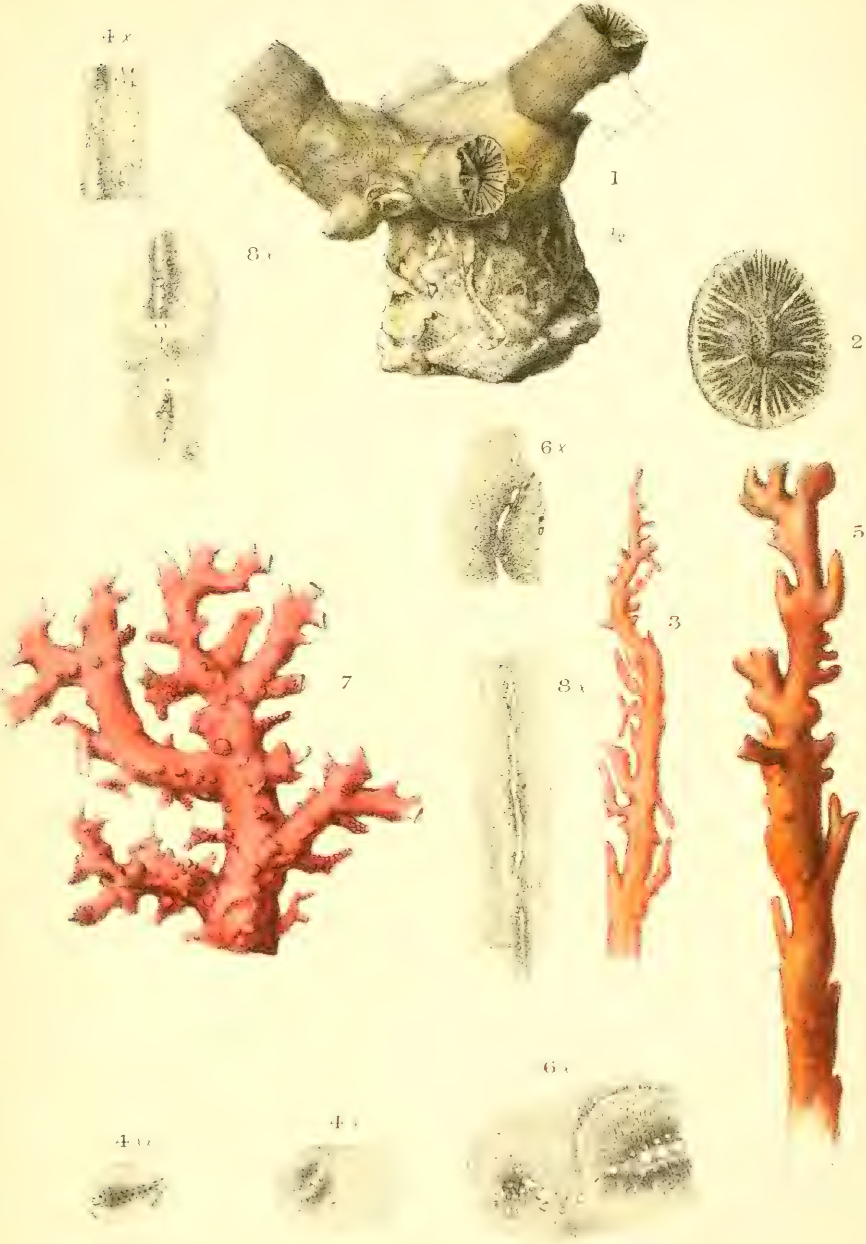

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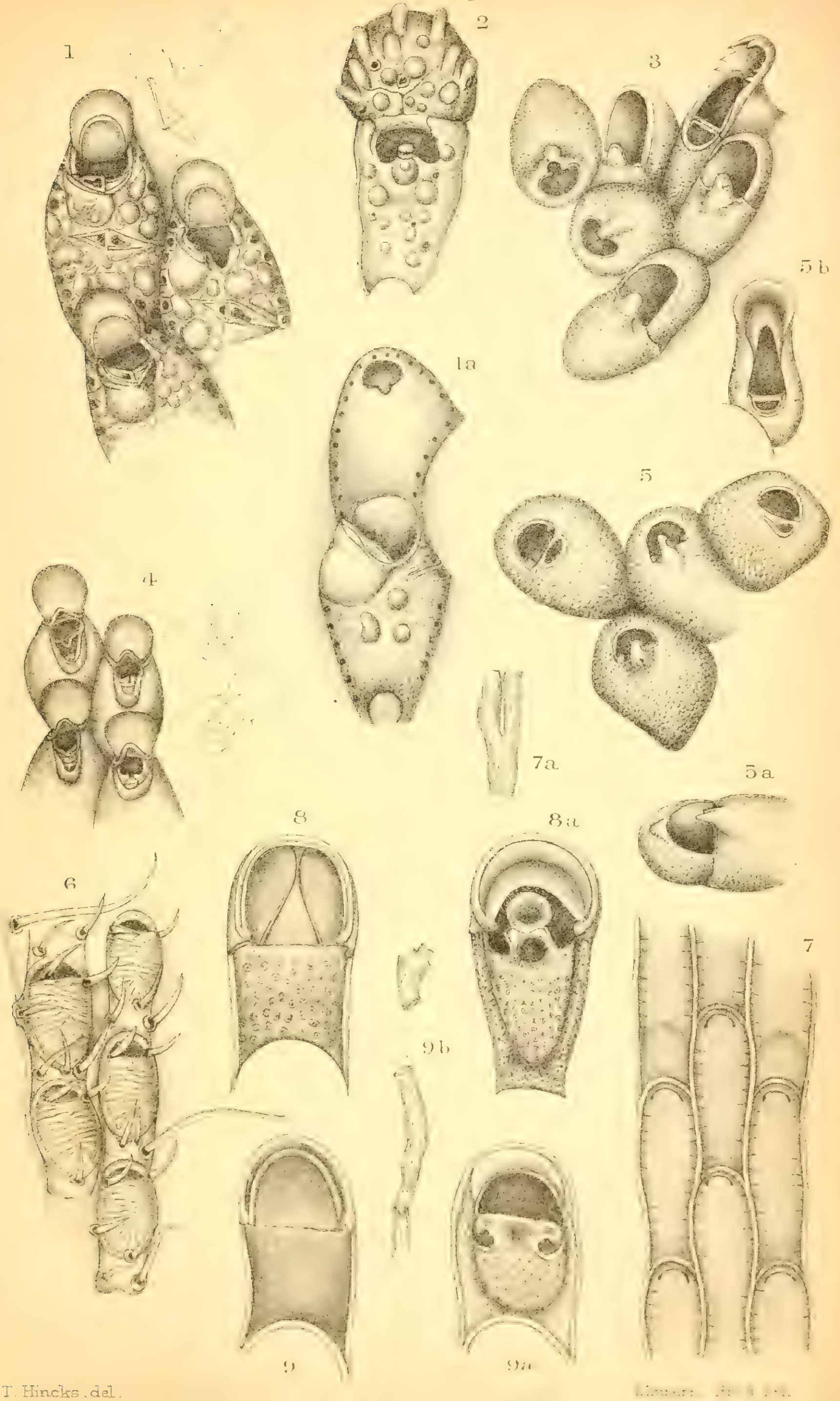

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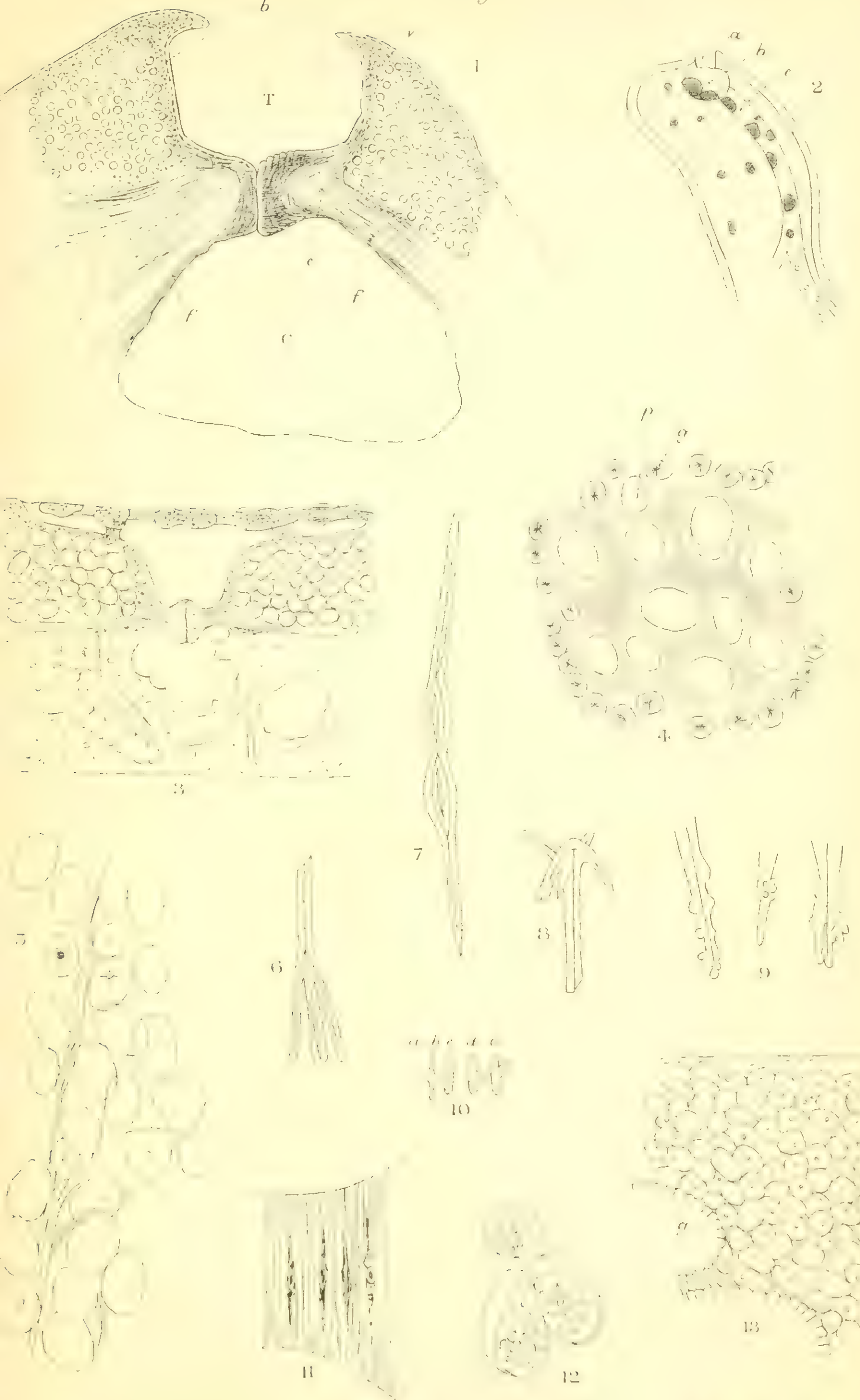

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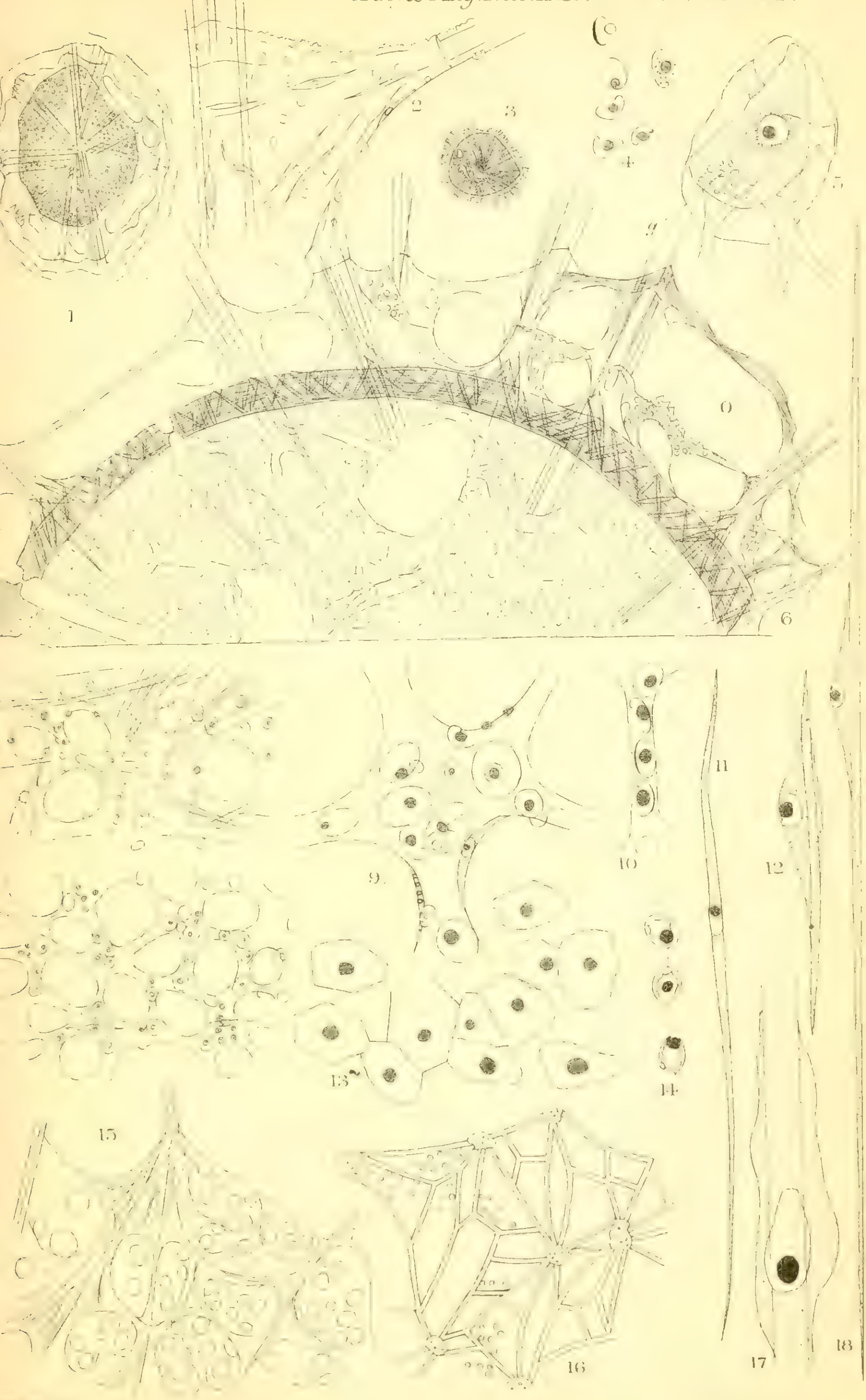

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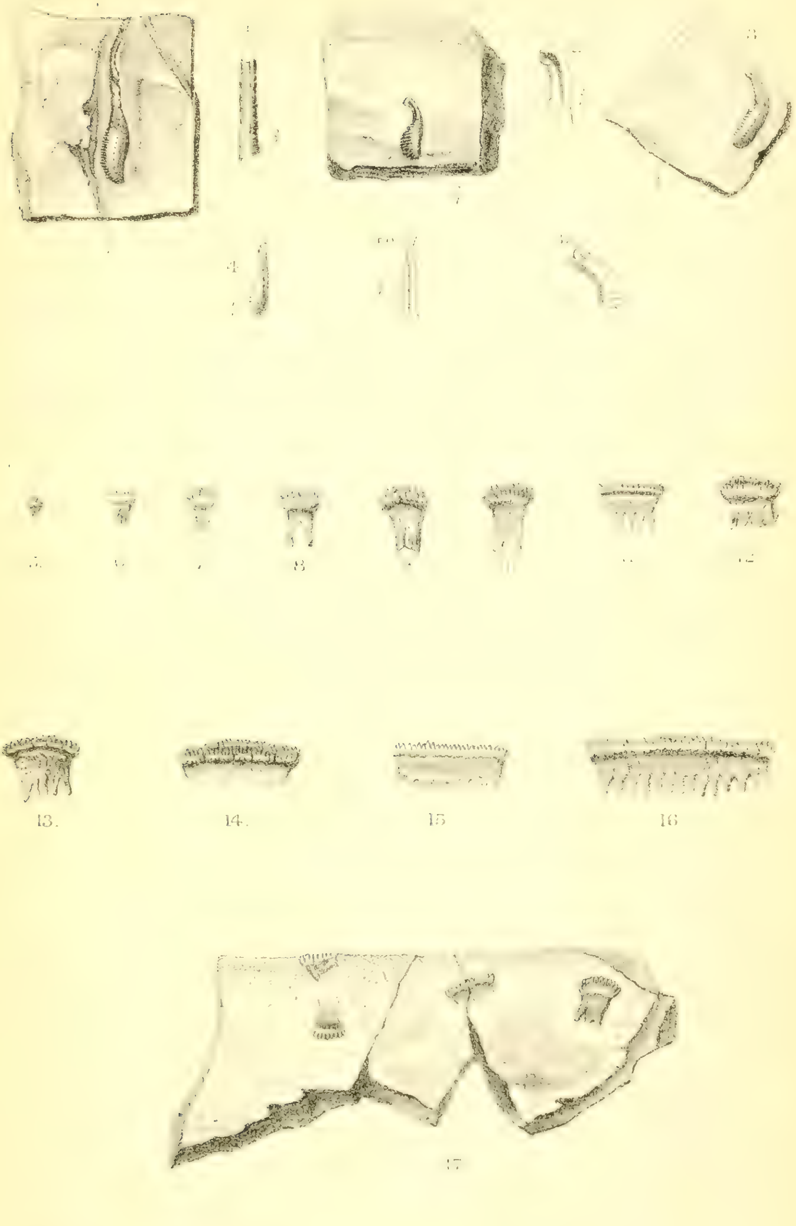
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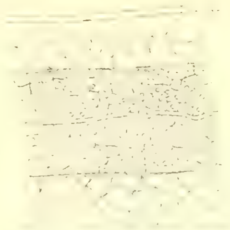
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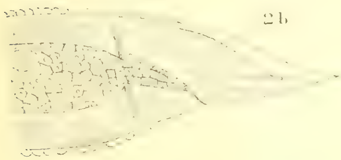
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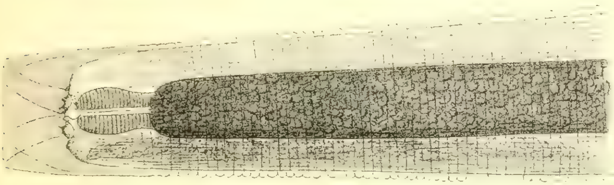
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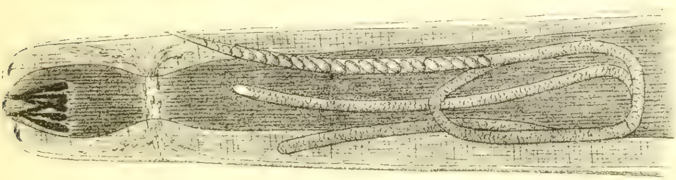
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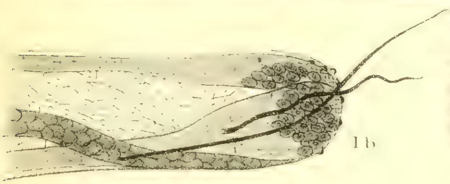
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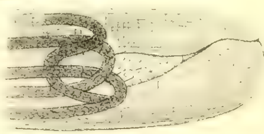
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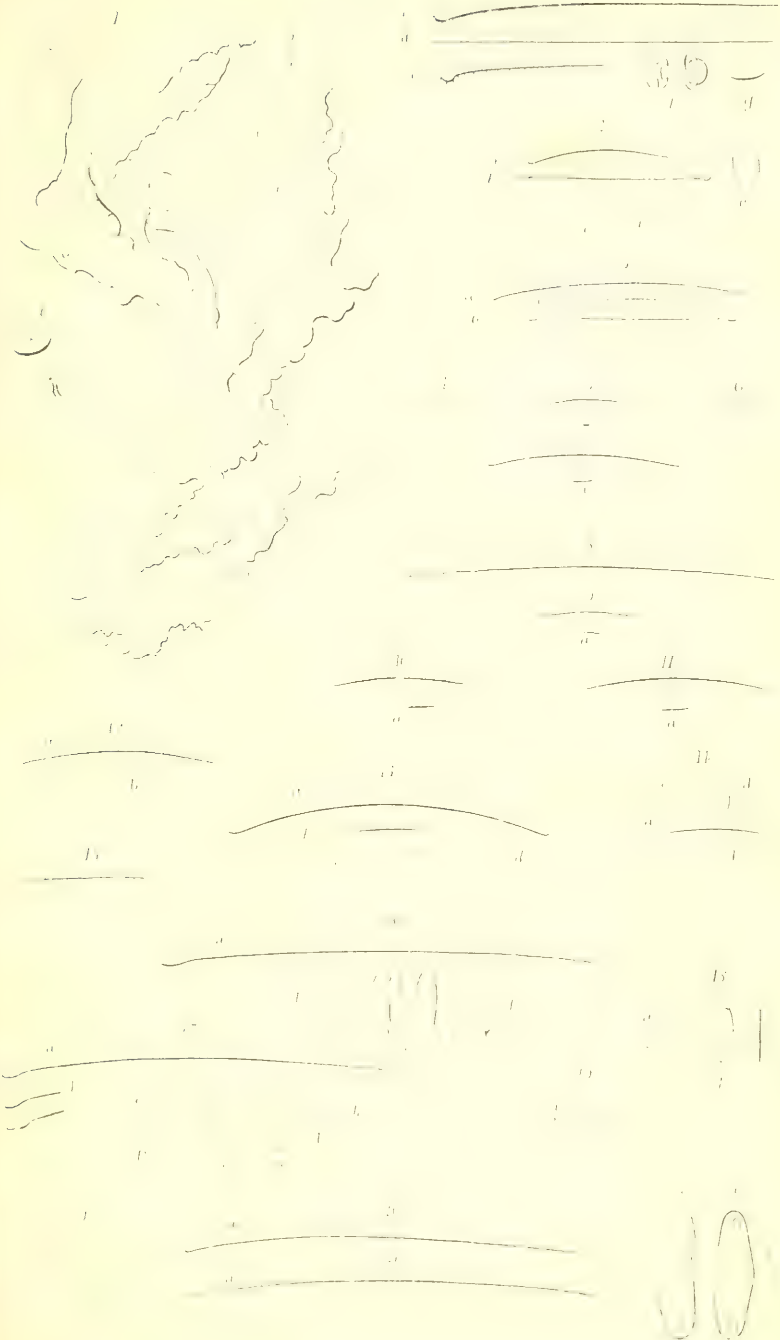

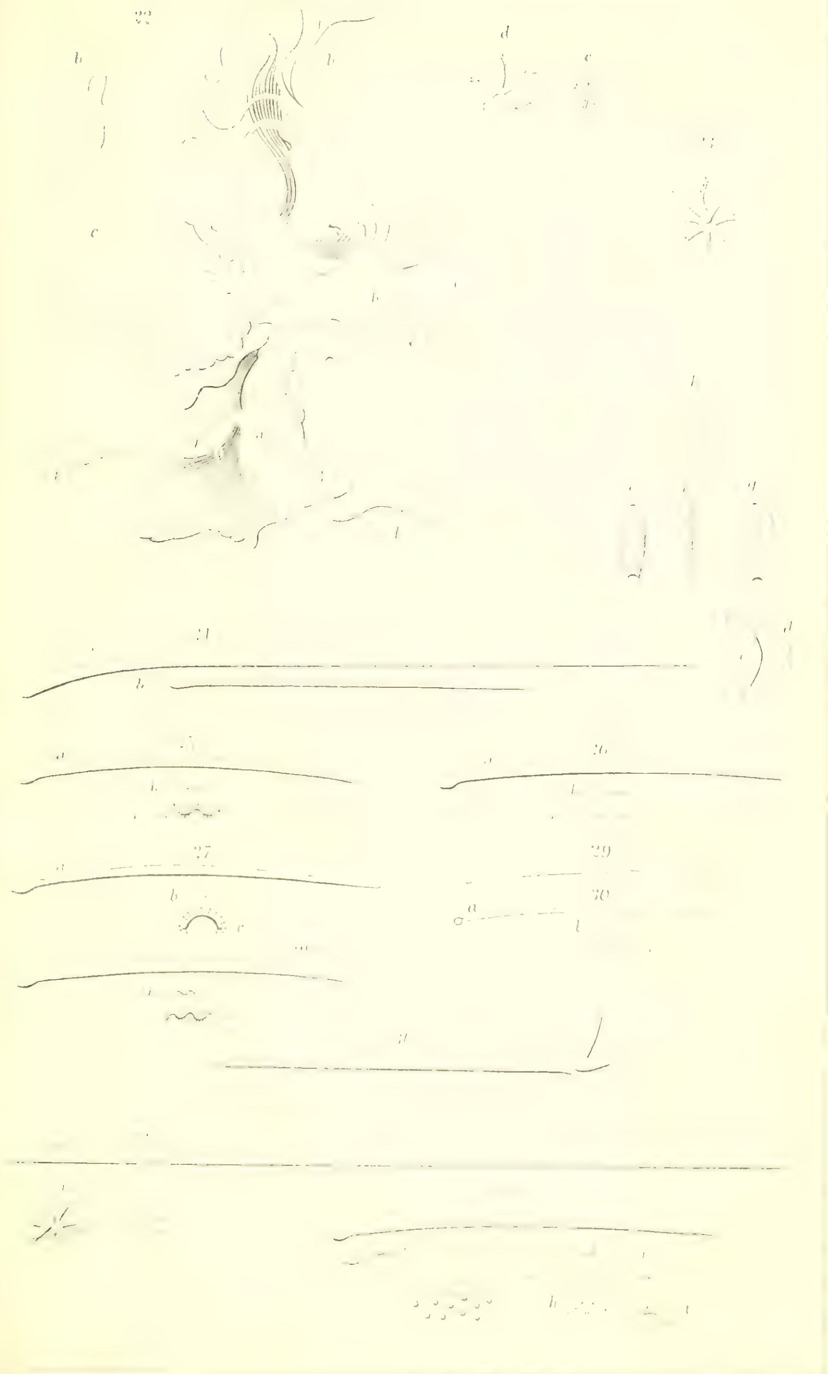

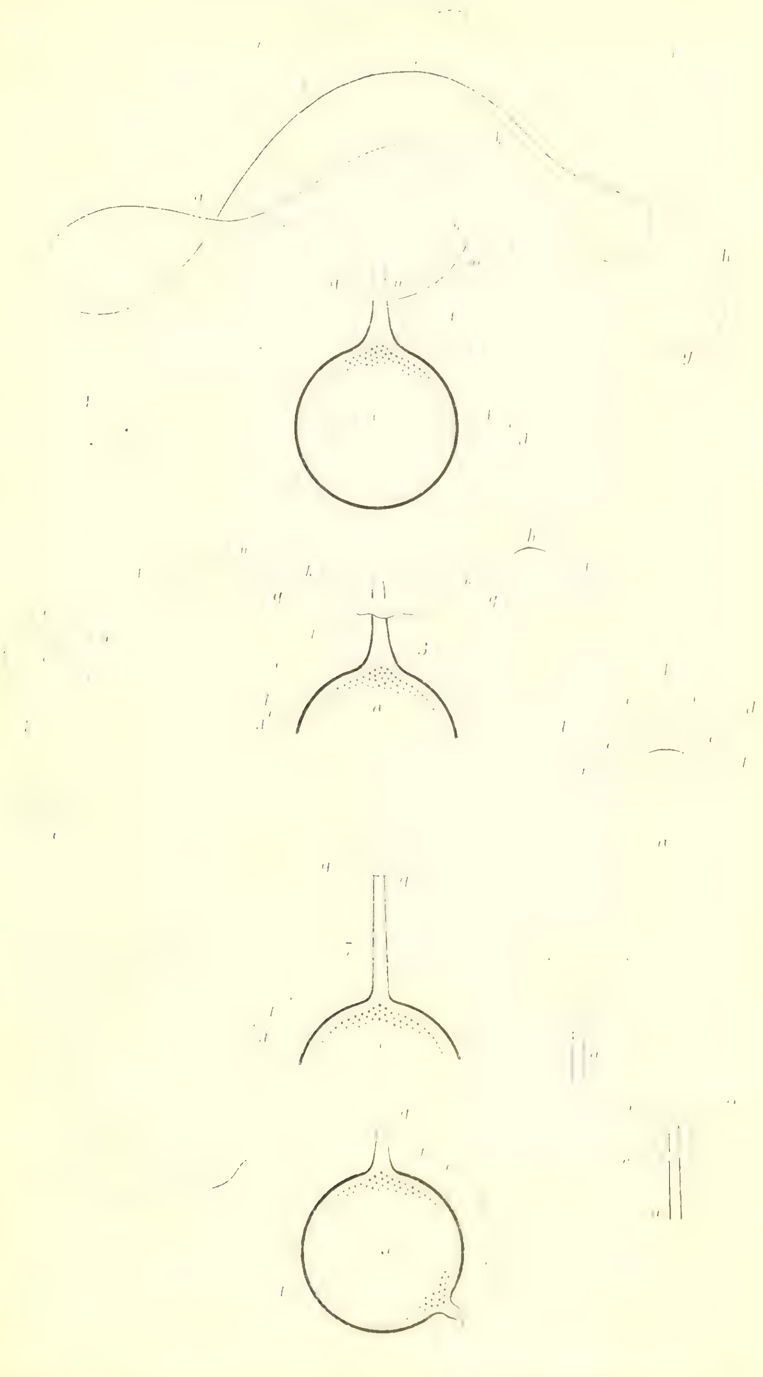

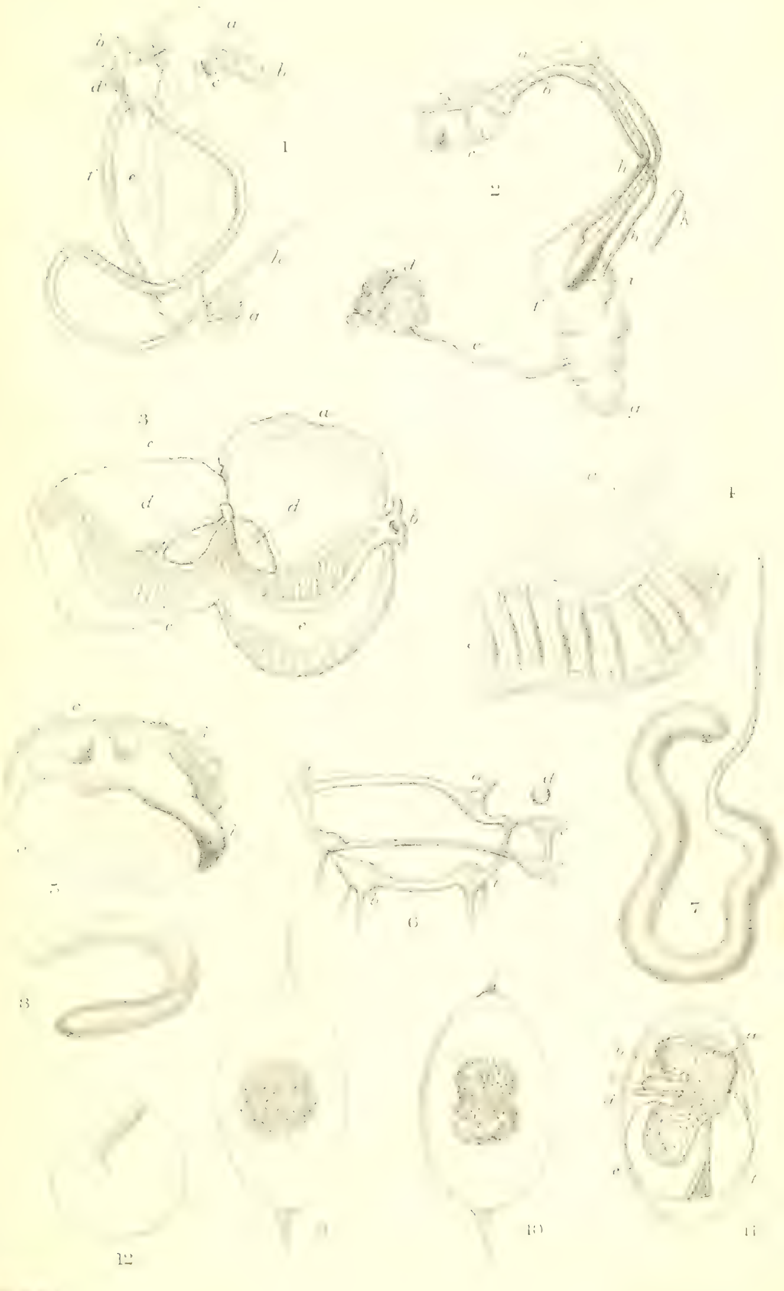

F. W. B. del.

Mintern Bros imp.